THE

AMERICAN NATURALIST

VOL. XXIV. APRIL, 1890. 280.

ON THE BRECCIATED CHARACTER OF THE ST. LOUIS LIMESTONE.

BY C. H. GORDON.

IN the absence of the Chester, the St. Louis beds constitute the uppermost division of the Subcarboniferous in Iowa. They consist generally of limestone above, yellowish-gray, more or less magnesian layers below, with a light gray friable sandstone between. The character of the limestone constituting the uppermost division is such as to merit more than a passing notice.

Throughout its area in Iowa, and its northern outcrop in Illinois, it has a peculiar brecciated or concretionary structure, not observed elsewhere. It is made up of a mass of angular limestone fragments, which have become more or less firmly recemented together. The stratification is very irregular, though in some places, where the brecciated character is absent, it is found even enough to furnish very excellent building stone. It is generally hard, and often cherty, and where it forms the floor to the coal measures, constitues a very excellent guide to those in search of this useful deposit. Its cherty character makes it very difficult to penetrate, and so when once reached it is readily recognized. In its typical locality—at and about St. Louis, where it was first studied by Dr. Shumard—it is described as a fine-grained, compact, subcrystalline limestone, often enclosing numerous cherty concretions, and the layers separated by thin

green shale beds. It thus appears that the lithological character of these beds changes toward the south.

The question as to the cause of the peculiar brecciated character of the limestone in Iowa and adjacent parts of Illinois presents a pertinent field of inquiry. Worthen and Hall make frequent mention of this feature of the St. Louis limestone, and White goes so far as to say that "during the time of the deposition of this limestone there seems to have been some slight disturbance of the strata, apparently amounting only to local disarrangements of its own layers. This is principally shown in the upper division, and consists of the slipping, bending or slight distortion of all the strata, also by the breaking up of that limestone into angular fragments which have in many cases become recemented together by similar limestone material, forming the breccia above referred to. The most of the disturbance seems to have prevailed during the deposition of the upper division."[1] It would be exceedingly interesting to learn the nature of these local disturbances. Hall speaks of it as follows: It "consists generally of a breccia composed of fine, compact, ash-colored limestone in fragments of various sizes, having the interstices filled with a subcrystalline, yellowish, granular, calcareous material, which is sometimes quite pulverulent, and rarely very compact. The rock at Keokuk, and at points above this on the river, as well as at Mt. Pleasant and elsewhere, appears like the attenuated margin of a more important formation, presenting the usual fractures of the thinning out of a limestone, viz., a brecciated and concretionary structure. This presumption proves to be true, for as we trace the rock southward beyond the state, it presents other aspects, gradually losing its concretionary and brecciated character, and becoming a more important limestone formation."[2]

This explanation can hardly be considered adequate, for it would necessarily follow that the attenuated margins of all limestones should present the same characteristics; whereas they do not. That the brecciated character is a marginal attendant in

[1] Geological Survey of Iowa 1870, Vol. I., p. 218.

[2] Geological Survey Iowa, 1858, Vol. I., Part 1, p. 98.

this case cannot be gainsaid; but that the shore line is always thus attended cannot be sustained by facts. The stress laid upon this feature of the St. Louis limestone by Worthen, White, and even Hall himself, is of itself sufficient to necessitate an additional explanation of its cause.

Another important feature of this limestone not yet noted, and one of great significance, is its oölitic character. In the Iowa Reports this is not mentioned by White, though noted several times in the detailed observations by Prof. Worthen in Hall's Report of 1858, as also in the Illinois Reports.

"Above it becomes a regularly bedded light gray limestone, in strata from six to twenty inches in thickness, the upper layers having an oölitic structure."[3] In the vicinity of Keokuk, Iowa, the semi-oölitic character may also be observed, though not especially prominent.

In Illinois it was observed by Worthen at several localities: "Oölitic beds are quite characteristic of this division, and in Hardin county massive beds of oölitic limestone form the upper portion of it at several localities. . . . . About three miles above Alton there are some oölitic and semi-oölitic beds in the lower part of the division, which are characterized by great numbers of small shells."[4]

In Indiana the oölitic structure is especially prominent, occurring in massive strata twenty to thirty or more feet in thickness in the counties of Owen, Monroe, Lawrence, Washington, Harrison, and Crawford.

The quarries in these counties supply a most excellent building stone, which is becoming quite celebrated for its durability, as well as the facility with which it may be dressed to any desired form.

It "has been formed from the crushed remains of marine shells, corals, etc. These have been pulverized to the condition of fine sand, their soluble impurities washed away, and their insoluble residue reunited into solid rock by a deposit of carbonate of lime as a cementing material. . . . . Its rich gray color, close

[3] At Croton, Ia. Hall's Report, 1858, p. 191.

[4] Illinois Report, Vol. I., p. 88.

and uniform texture, and facility of working, both by hand and machinery, make it extremely valuable for architectural purposes, and its assured strength and durability make it especially desirable for all permanent engineering works."[5]

Another notable feature of this limestone, especially in Iowa, is its irregularity as to thickness: frequently varying from ten to fifty feet within very short distances. At Keokuk the thickness is from ten to twenty feet; following up the Des Moines river, the course of which is nearly parallel with its original outcrop, its thickness increases until we reach Farmington, where it measures seventy-five feet. Between this place and Bentonsport, thirteen miles beyond, it decreases to four or six feet. This irregularity in thickness is accompanied by trough or basin-like depressions in the surface of the limestone, in which the coal measures were afterward deposited. A miniature basin of this kind occurs at Hillsborough, while at Farmington the coal occurs in a more extensive depression. At Hillsborough the basin is "oval in form, and does not exceed fifty paces in diameter in either direction. The coal dips rapidly from the edge to the centre, where it is about fifteen feet below the surface of the limestone, outcropping around the rim of the basin."[6] Fig. 1, Plate X., shows a cross-section of this basin:

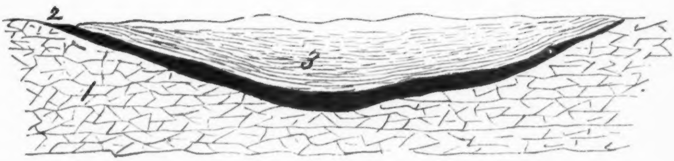
We have observed the same irregularity in the surface of this limestone at Keokuk, the thickness at one place being diminished by half in a distance of one hundred feet. The accompanying section across Point Keokuk from northeast to southwest (Fig. 2, Plate X.,) shows the observed position of these beds.

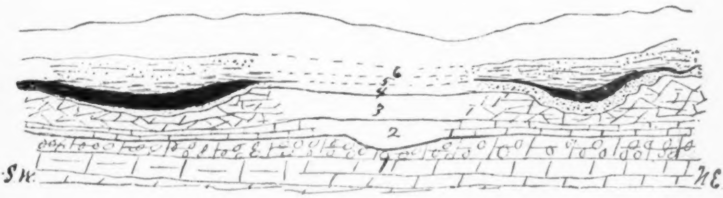
Toward the northeast the junction of the sandstone with the limestone may be observed, showing very conclusively the uneven surface of the limestone, and, a few inches above, a black coaly layer, here amounting to a mere parting, but which rapidly thickens to a layer ten or twelve inches in thickness, accompanied by a still greater thickness of slate. This basin is apparently a very small one. Within the limits of the city these rocks have been mostly removed by erosion. A similar basin occurs toward

[5] Indiana Report, 1881., p. 29, et seq.

[6] Hall's Iowa Report. Vol. I., Part 1., p. 223.

PLATE X.





THE ST. LOUIS LIMESTONE.

the south, but we have not observed the underlying sandstone. Here the coal is found eighteen to twenty inches thick.

The facts above cited would seem to warrant certain conclusions as to the conditions under which the limestone was deposited. Its general character would seem to imply the existence of coral reefs fringing the shore throughout its northern extent. The accompanying map (Plate XI.) shows approximately the expanse of the Gulf during the St. Louis epoch.

The probable direction of the Gulf Stream is indicated by the arrows. The proof of the existence of marine currents and clear waters along the borders in Iowa, Illinois, Indiana, and southward, lies in the presence at these points of extemsive beds of limestone. It would seem improbable that any communication with the ocean existed to the north and east, for had such existed the Gulf Stream would, doubtless, have taken that direction, involving clear waters and limestone deposits; whereas, the arenaceous and argillaceous characters of the Lower Carboniferous of Ohio are marked. The northern extension of the Gulf Stream, bringing with it the warm waters of the Tropics, would materially affect the climate of this region, and in part explain the tropical conditions during the following epoch.

The causes operating to exclude corals from tropical coasts, as shown by Dana,[7] are: (1) cold extratropical ocean currents; (2) muddy, or alluvial shores, or the emptying of large rivers; (3) presence of volcanic action; (4) depth of water on precipitous shores. The first and third were manifestly absent. That the shores were not muddy is shown by the presence of the limestone as noted above.

The general dip of the strata here is toward the south and west. It is very slight, but increases along the Mississippi, after leaving the lower line; it changes, however, so as to bring the Lower Carboniferous again to the surface in the region of Quincy, Ill.

There is thus afforded just such a shelving shore as would comport with required conditions.

It is therefore not at all improbable that a line of reefs occupied

[7] Manual, p. 617.

this northern shore line, just as Florida is now fringed by its existing representative.

This conclusion is strengthened by the resemblance of the St. Louis limestone to coral rocks. Dana[8] describes coral rocks as: (1) fine-grained, compact, clinking limestone, with or without fossils; (2) a compact oölite; (3) a conglomerate, mostly of corals and shells; (4) a rock consisting of corals as they grew,—the interstices filled in with coral sand, shells, and fragments, sometimes very loosely. By the incessant trituration of the waves the original features of coral rocks are to a great degree lost, and the oölitic and brecciated characters are the most prominent remaining features.

From Le Conte[9] we learn that "in some places . . . . it (coral rock) is a coarse conglomerate or *breccia*, composed of fragments of all sizes cemented together; in other places it is made up entirely of rounded granules of coralline limestone (coral sand) cemented together, and forming a peculiar oölitic rock. But the larger portion of the reef ground is a fine, compact limestone, made up of comminuted coralline matter (coral mud) cemented together. This fine coral mud is carried by waves and tides into the lagoon and serves to raise its bottom; it is also carried by currents and distributed widely over the neighboring sea bottoms. . . . . . In some places it (reef rock) contains imbedded remains of corals and shells, but in other parts it is entirely destitute of these remains."

The corroborative evidences of a like origin for the St. Louis limestone may be briefly summarized as follows:

1. In its brecciated character and uneven stratification it closely resembles the brecciated portions of coral rock now forming. In general the fragments are composed of fine-grained bluish-gray limestone, resembling the clinking limestone of the coral seas. The only coral generally distributed through it is the massive *Lithostrotion canadense* Castelnau, the remains of which are abundant and conspicuous. The remains of this fossil occur at numerous localities in Iowa, Missouri, Illinois, Indiana,

[8] Manual, p. 620.

[9] Elements, p. 148.

PLATE XI.

THE CARBONIFEROUS OCEAN AND CONTINENT.

Kentucky, Tennessee, and Alabama. "This fossil is one of the most widely distributed corals of the Carboniferous limestones, and appears to hold the same geological position from Central Iowa to Alabama, everywhere marking the horizon of the St. Louis limestone."[10] In Iowa both the fossiliferous and unfossiliferons kinds of rock may be observed in the regions of the brecciated limestone. In some cases masses of the coral are found unbroken, but usually they are in a fragmental condition. In the vicinity of Keokuk we have observed places at which the limestone pieces are conspicuously fossiliferous, abounding in broken fragments of the above coral, as well as other fossils in a more or less comminuted condition. On the whole, however, the brecciated portions are comparatively unproductive of fossils. It is significant that n its extension northeastward into Ohio and Pennsylvania no remains of *L. canadense* are found, though Meek has shown this formation to be present in that region.

2. The character of the St. Louis towards the south corresponds with what might be expected in its more seaward portions It there becomes more evenly stratified and greatly more fossiliferous. The brecciated character is nearly lost, appears only at intervals, beginning and ending abruptly, and the intermediate portions showing more or less oblique laminations.

4. The uneven surface of the brecciated limestone would be a necessary sequence of the development of land seaward along a reef-bound coast.

On the retreat of the sea the lagoons and intermediate spaces were filled by shore-wash, accompanied by a luxuriant vegetation, and land progression outward, similar to that of Florida, as shown by Agassiz, in more recent times. Under this hypothesis the irregular pockets and basins of coal in the Lower Coal Measures are easily accounted for. They result from the accumulation within the lagoon of vegetation growing upon the banks or transported from without. That in these cases it did not in all cases grow in situ would appear from the fact that the coal rests almost immediately upon the limestone with no intervening layer to form a soil for its growth. In other localities the coal is under-

[10] Hall. Geology Iowa, Vol. I., Part II., p. 668.

laid by a stratum of soft, coarse sandstone. In this connection it might be objected that the above explanation would make the deposit of sandstone contemporaneous with the growth of some portions of the coral reef, in which case it should contain some internal proof of proximal relations. Such proof is not wanting. On the Iowa side of the Mississippi river, one-half mile above Keokuk, the brecciated limestone is overlaid by fifteen feet of this sandstone, which is somewhat harder than usual elsewhere, forming a projecting ledge. At this locality the writer has observed a mass of *Lithostrotion canadense* five or six inches in diameter imbedded in the lower portions of the sandstone, about two feet above the base. The presence of the coral here is accounted for on the supposition that at some not distant point a coral reef was growing at the time this sandstone was deposited. By the action of the waves this mass was broken from its bed and driven along the shallow bottom to find at last a resting-place in the mud and detritus brought in from the neighboring land. That the distance may not have been great may be inferred from the known fact that in coral regions the transition from a bottom of coral detritus to one of mud or earth is often very abrupt.[11]

From the above we submit the following brief

RECAPITULATION:

1. The Upper Division of the St. Louis Beds is a limestone which in its northern extension is decidedly brecciated and irregular in stratification and thickness. In the interior, with a few exceptions apparently due to littoral conditions, the rock is of a fine-grained, even texture, and regular stratification.

2. No adequate cause for this prominent feature of the limestone has thus far been advanced. While present in the attenuated margins of some limestones, it is not in all, and hence would imply the existence of other than littoral conditions alone.

3. Another significant feature accompanying the brecciated structure of this limestone is its oölitic character.

[11] Dana, Manual, p. 623.

4. In these and other features the limestone shows marked resemblances to that observed in coral regions.

5. The conditions for the growth of reef-building corals were apparently present at the time of the deposition of the St. Louis Beds. That the *Lithostrotion canadense* and *L. proliferum* were reef-building corals seems quite probable, though scarcely susceptible of proof.

6. The presence of coral reefs along the shore-line during the St. Louis epoch would seem to account for the various peculiarities of structure and arrangement observed in this limestone.

Keokuk, Ia., March, 1890.

THE HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from p. 157, Vol. XXIV., 1890.)

PORTUGAL CABBAGE. *Brassica oleracea costata* D.C.

THIS cabbage is easily recognizable through the great expansion of the midribs and veins of the leaf, in some cases forming quite half of the leaf, and the midrib losing its identity in the multitude of radiating branching veins. In some plants the petioles are winged clear to the base. Nearly all the names applied to this form indicate its distribution, at least in late years, from Portugal, from whence it reached English gardens about 1821,[1] and in American gardens, under the name of Portugal Cabbage, about 1850.[2] It should be remarked, however, that a *Choux a la grosse cote* was in French gardens in 1612,[3] and in three varieties in 1824.[4]

[1] Hort. Soc. Trans., 1821, 12.

[2] Buist. Fam. Kitch. Gar., 1851.

[3] Le Jard. Solit., 1612, 158.

[4] L'Hort. Franc., 1824.

This cabbage varies in a direction parallel to that of the common cabbage, or has forms which can be classed with the kales, and the heading cabbages of at least two types.

The peculiarity of the ribs or veins occasionally appears among the variables from the seed of the common cabbage, whence atavism as the result of a cross can be reasonably inferred. As to the origin of this form, our opinion, at the present stage of our studies, must be largely speculative, but we may reasonably believe that it originated from a different form or a different set of hybridizations than did the common cabbage.

The names in English are *braganza*, *portugal* or *sea-kale cabbage*,[5] *large-ribbed cabbage*,[6] *large-ribbed borecole*, *tranxuda*,[7] *couve tronchuda*; in France, *choux a grosses cotes*, *chou tronchuda*; in Spain, *col de pezon*, *col tronchuda*; in Portugal, *couve tronchuda*, *couve mantiega*, *couve penca*.[8]

The synonymy appears to be:

Choux a le grosse cote. Le Jard. Solit., 1612.
Chou blond a grosses cotes. Bosc. Dict., 1789, 4, 43.
Brassica oleracea aceppala costata. D.C. Syst., 2, 584.
B. oleracea costata. D.C. Mem., 1821, 12.
Chou a grosse cotes. Vilm., 1883.

POT MARIGOLD. *Calendula officinalis* L.

The flowers are used in some culinary preparations, and for this purpose it is yet grown in some gardens. It has not been used to any great extent in modern times, and even in 1783 Bryant,[9] while noting its common occurrence in gardens, says that the flowers were formerly in high esteem, being gathered and dried to use in soups and pottage. It was in American gardens in 1806. The plant was described in nearly all the early botanies, and is mentioned by Albertus Magnus in the 13th century.

[5] Vilmorin. The Veg. Gard., 1885, 128.
[6] Booth. Treas. of Bot.
[7] Burr. Field and Gard. Veg., 1863, 273.
[8] Vilmorin. Les Pl. Pot., 1883, 126.
[9] Bryant. Fl. Diet., 1783, 146.

Pot marigold is called, in France, *sonci des jardins;* in Germany, *ringelblume;* [10] in Holland, *goudbloem;* in Italy and Spain, *calendula;* in Russia, *nogotki;* [11] in Arabia, *zobejbe;* by the Greeks at Constantinople, *chamobuoreta;* [12] in Hindustani, *gul-i-mariyam, phirki, genda;* in Bengali, *genda phul;* in Burma, *htat-ta-ya;* at Lahore, *adsrioon;* in Japan, *kin-sen-kwa.* [13]

POTATO. *Solanum tuberosum* L.

The varieties of the potato are now innumerable, and while of several distinct types of form and color, are all supposed to have been derived from a common wild progenitor. It is interesting to observe, therefore, that varieties were under culture in South America even before the discovery. In a vocabulary of a now extinct tribe, the Chibcha, who once occupied the region about the present Bogota, ten different varieties are identified, one of which, "black inside," has not as yet appeared in modern culture.[14] At the present time Vilmorin [15] makes an extremely artificial classification, as follows: 1, the round yellow varieties; 2, the long yellow varieties; 3, the variegated long yellow varieties; 4, the round red varieties; 5, the flat pink or red varieties; 6, the smooth long red varieties; 7, the notched long red varieties; 8, the violet colored and variegated varieties. The yellow and red varieties are mentioned by Bauhin [16] in 1596, "fusci vel atrorubentis," or literally, the tawny and the purple. In 1726 Townsend [17] mentions the white and the red in England, as does Bryant [18] in 1783. In 1785, Varlo [19] describes nine sorts, the white round, the red round, the large Irish white smooth, the

[10] Vilmorin. Les Pl. Pot., 551.

[11] McIntosh. Book of the Gard., II., 240.

[12] Forskal. Fl. Æg. Arab., CXX., XXXIII.

[13] Pickering. Ch. Hist., 550.

[14] Gramatica Vocabulario . . de la Lingua Chibcha, for Don E. Urichoechea, quoted in Gard. Chron., Dec. 4, 1886, 720.

[15] Vilmorin. The Veg. Gard., 1885, 443.

[16] Bauhin. Phytopin., 1596, 301.

[17] Townsend. Seedsman, 1726, 23.

[18] Bryant. Fl. Diet., 1783, 15.

[19] Varlo. Husbandry, 1785, II., 97.

large round red, the culgee, the early-wife, the white kidney, the bull's-eye red. In further description he says the Jerusalem is long and full of eyes, the culgee is red on one side, the early-wife does not blossom, and are of a light-red, and the toadback is nearly akin to the large Irish, the skin almost black, and rough like a russetting; the kidney is oblong, white with a yellowish cast. In 1806 McMahon [20] describes but one kind for American gardens, but in 1828 Fessenden says there are many varieties, and in 1832 Bridgeman says the varieties are very numerous. In 1848 nearly one hundred sorts were exhibited at the Massachusetts Horticultural Society in Boston. Decaisne and Naudin give the number of varieties in France in 1815 as sixty; in 1855 as four hundred and ninety-three, in 1862 as five hundred and twenty-eight.

We have grown a number of wild varieties of the potato at the New York Agricultural Experiment Station, including the *Solanum maglia*. One sort, which has not as yet been identified by us with its specific name, corresponds to the notched class of Vilmorin. The *maglia* corresponds to the round and oblong flattened forms; the *Jamesii* to the round form. The colors of these wild potatoes are said by some growers to include the white, the red, and the variegated. In their habits of growth the *maglia* forms its tubers deep under the ground, the *Jamesii* very much scattered and extending a long distance from the plant.

The synonymy of our types can include those described by Vilmorin, as follows, but I have not attempted to make it complete.

I. *Round yellow.* Vilm., 1885.
Round as a ball. Ger., 1597, 781; 1633, 927.
Solanum tuberosum. Blackw. Herb., 1773, pl. 523, b.
White round. Varlo, Husb., 1785, II., 97.

II. *Long yellow.* Vilm., 1885.
Ovall or egge fashion. Ger., 1597, 781; 1633, 927.
Oblonga. Bauh. Prod., 1671, 90. Matth., 1598, 757, cum ic.
Papas peruanorum. Clus. Rar., 1601, 2, 79, cum ic.

[20] McMahon. Am. Gard. Cal., 1806.

III. *Variegated l ng yellow.* Vilm., 1885.

IV. *Round red.* Vilm., 1885.
Pugni magnitudine. Matth., 1598, 757.
Red round. Varlo, Husb., 1785, II., 97.

V. *Flat pink or red.* Vilm., 1885.

VI. *Smooth long red.* Vilm., 1885.
?Solanum tuberosum. Blackw. Herb., 1773, pl. 523, b.

VII. *Notched long red.* Vilm., 1885.
?Membri virilis forma. Bauh. Prod., 1671, 90.

VIII. *Violet colored and variegated.*
?Atrorubens. Bauh. Phytopin., 1596, 301.
Toadback. Varlo, Husb., 1785, II., 97.
Solanum tuberosum tuberibus nigricantibus. Blackw. Herb., t. 586.

The figures I have seen, which seem to me to be referrable to the *maglia* species, are:

Batata virginiana sive virginianorum pappus. Ger., 1597, 781.

Solanum tuberosum esculentum. Matth., op., 1598, 758; Bauh. Prod., 1671, 89.

Arachidna theophrasti forte, Papas peruanorum. Clus. Rar., 1601, 2, 79.

Papas americanus. Swertius, Florelig., 1612, t. 28, fig. 4.

The potatoes which are now grown in this country were derived from several sources, from England, and of late years from Bogota[21] in 1847, from Chili[22] in 1850, etc.

Potatoes were grown in Virginia in 1609,[23] and are also mentioned in 1648[24] and 1650.[25] In 1683 Worlidge[26] says potatoes are much used in Ireland and America, but their introduction into New England is said not to have been until 1719,[27] at Lon-

[21] Farmers' Library, 1847, 382.

[22] Trans. N.Y. Ag. Soc., 1850, 726; 1851, 367.

[23] A True Decl. of Va., 1610, 13.

[24] A Perf. Desc. of Va., 1649, 4.

[25] Virginia, by E. W., 1650, 48.

[26] Syst. Hort. By J. W. Gent., 1683, 187.

[27] Hort. Register, III., 214.

dondury, N. H., and at Salem, about 1762.[28] In 1779, however, potatoes were among the Indian foods destroyed by Gen. Sullivan[29] during his invasion into Western New York.

This plant has secured a wide distribution, and has been successfully cultivated throughout nearly the whole world. Its northern limits are in Norway, 71° 7′; in Russia, the Pinega River, 65°; Turukansk, 65°; Yakutsk, shores of the Okotsk Sea, Kamchatka, Kadjah Island, Sitka Island; Mackenzie River, 65°; Canada, Labrador, 58° 45′; Greenland.[30]

The modern names for the potato are: In France, *pomme de terre, parmentiere, tartauffe, tartufle*, etc.; in Germany, *kartoffle;* in Flanders and Holland, *aard appel;* in Denmark, *jordepeeren;* in Italy, *patata;* in Spain and Portugal, *patatas;* in Spanish America, *papa;*[31] in Norway, *potet;*[32] in India, *wvlaetee aloo;*[33] in Telinga, *alu-guddalu;* in Ceylon, *rata-innala;*[34] by the Malays, *ubi bungala;*[35] in China, at Pekin, *shan-yas-tou;* in southern China, *ho-lan-shu.*[36]

PUMPKIN. *Cucurbita* Sp.

See under squash.

PURSLANE. *Portulaca oleracea* L.

Common purslane is a weed of the garden, and has spread over nearly the whole world. Whether originally an American plant is in doubt, but certain it is that plants *called* purslane were seen by the early visitors to the American coast. The cultivated purslane differs from the wild in being erect, and Hooker found

[28] Felt's Annals of Salem, II., 146.

[29] Conover's Early Hist. of Geneva, 1880, 45.

[30] Bergman. *Nature*, Aug. 21, 1884, 392.

[31] Vilmorin. Les Pl. Pot., 478. For Germany, see Die Deutschen Volksnamen d u Pflanzen. Pritzel and Jessen.

[32] Schubeler. Culturpf., 90.

[33] Speede. Ind. Handb. of Gard., 136.

[34] Birdwood. Veg. Prod. of Bomb., 174.

[35] Treas. of Bot., 1186.

[36] Bretschneider. On the Study, etc., 17.

in northwest India a variety with erect stalks.[37] The use of the purslane as a vegetable is noted in the Greek writers under the name *andrachne*, and by the Romans under this name and *portulaca*. In the 13th century Albertus Magnus [38] does not mention culture in gardens, and apparently refers to the wild form, "the stems extending over the soil." In 1536 Ruellius [39] describes the erect, green-leaved, cultivated form, as well as the wild procumbent form, and in this he is followed by many of the succeeding botanists. Three varieties are described,—the green, the golden, and the large-leaved golden. The golden varieties are not mentioned by Bauhin in his phytopinax, 1596, nor in his pinax, 1623, but are mentioned just as if a well-known variety in Le Jardinier Solitaire, 1612. The green variety is figured by nearly all the earlier botanists. The golden has the following synonymy:

Pourpier dore. Le Jard. Solit., 1612, 378; Tourn., 1719, 236; Vilm., 1883, 518.

Red or Golden. Quintyne, 1693, 199.

Portulaca sativa lutea sive aurea. Ray, 1688, 1039.

Golden purslane. Ray, 1688, 1039; Townsend, 1726, 19; Mawe, 1778; Burr, 1863, 392.

Purslane was formerly much more grown than at present; with Quintyne it was a vegetable for forcing. It is seldom seen in American gardens, but the spinage from the wild plant is occasionally served at table.

Purslane is called in France, *pourpier*, *porcelin*, *porcellane*, *porchailles;* in Germany, *portulak*, *kreusel;* in Flanders and Holland, *postelein*, *postelijn*, *porcelein;* in Denmark, *portulak;* in Italy, *porcellana;* in Spain, *verdolaga;* in Portugal, *beldroega;* [40] in Norway, *portulak;* [41] in Russia, *schrucha*.[42]

In Arabia, *brabra*, *chamile*, *doenneb el farras*, *ridjlet el farras;*[43]

[37] Hooker. Fl. Br.-Ind., I., 240, ex. D.C. Orig. Des. Pl. Cult., 70.

[38] Albertus Magnus. De Veg., Jessen ed., 1867, 548.

[39] Ruellius. De Nat. Stirp., 1536, 482.

[40] Vilmorin. Les Pl. Pot., 517.

[41] Schubeler. Culturpf., 109.

[42] Decandolle. Orig. Des Pl. Cult., 70.

[43] Forskal. Fl. Æg., Arab., CXII.

in Arabic, *rigleh;*[44] in Bengali, *moonya, buroloonia;*[45] in Burma, *myae-byet;*[46] in Ceylon, *genda-kola;*[45] in China, *ma chi hien;* in Cochinchina, *rau sam;*[47] at Constantinople, *glisrida;*[43] in Egypt, *baglae, ridjle;*[46] in India, *choolee, mooncha, moonea, khursa, khurfa;*[48] in Japan, *bakin, uma biju, siberi fiju;*[49] in Nubia, *segettemum;*[44] in Persia, *turuek, kherefeh;* in Sanscrit, *lonika, loonia;* in Tamil, *caril-keeray, puropoo-keeray.*[45]

QUINOA. *Chenopodium quinoa*, Willd.

This plant was grown as a cereal plant in the table-lands of New Grenada, Peru, and Chili, at the time of the discovery of America, and De Vega[50] notes that both the Indians and the Spaniards use the foliage as a spinach, as well as the grain. In Chili a variety is named by Molina,[51] which yields a white grain, and this is the kind that is used as a vegetable in European gardens. A black-seeded variety, cultivated in gardens, is mentioned by Feuille[55] in Peru, preceding 1725. It was introduced in 1785,[52] but has not received very extended use. In 1853 seeds from France were distributed from the U. S. Patent Office.

The *white quinoa* is called in France, *anserine quinoa blanc, quinoa blanc;* in Germany, *peruanischer reis-spinat, reis-gewachs;*[53] in Peru, *quinua* by the Indians, *mujo* by the Spaniards;[50] in Chili, the white sort, *dahue;*[51] in Bolivia, *quinua.*[54]

RADISH. *Raphanus sativus* L.

In European culture the radish is grown for its roots, but in other countries it is grown as well for its leaves and seed. Thus

[44] Delile. Fl. Æg. Ill.

[45] Birdwood. Veg. Prod. of Bomb., 38, 161.

[46] Pickering. Ch. Hist., 611.

[47] Louriero. Fl. Cochinch., 293.

[48] Speede. Ind. Handb. of Gard., 171.

[49] Kaempfer. Amoen., 831.

[50] G. de Vega. Royal Com. Hak. Soc., ed. II., 358.

[51] Molina. Hist. of Chili, I., 91.

[52] Heuze. Les Pl. Alim., II., 259.

[53] Vilmorin. Les Pl. Pot., 1883, 10.

[54] Gibbon. Amazon, 139.

[55] Feuille. Peru, III., Ap. 16, t. X.

in Sikh, India, Edgeworth[56] says the radish is cultivated both as a vegetable made of the young buds, and for its oil. In Arabia Forskal[57] says the foliage and not the root is eaten. The Arabs are very fond of the tops of radishes, says Bayard Taylor,[58] and eat them with as much relish as donkeys. Klunzinger[59] describes the radish of Upper Egypt as of a peculiar kind, of which as a rule the leaves only, and not the small sharp root, are eaten. In 1726, in England,[60] radishes were sown for cutting in the first leaf for small salads. The oil-bearing radish of China is grown extensively there for the seeds, from which an edible oil is expressed, and it has been introduced and successfully cultivated in Italy, whence it has reached France.[61] This esculent root has been known from a remote antiquity, and has furnished a number of forms which have remained distinct from time immemorial. If the figures given by Woenig[62] as of the radish in the XII. dynasty of Egypt be the radish, we may recognize the turnip-rooted and the long. A. P. Decandolle[63] in 1821 divided the radishes into two divisions, the one including the common European sorts, the other the large black or white winter sorts. As a matter of convenience we will treat the various forms as species, giving the history of each.

I. *Raphanus radicula* Pers.[64]

This is the round or turnip radish, the root swollen into a spherical form, or an oval tube rounding at the extremity to a filiform radicle. It has several shades of color, from white to red or purple. Its savor is usually milder than that of the other

[56] Edgeworth. Hooker's Jour. of Bot., II., 273.

[57] Forskal. Fl. Æg.-Arab., XCIII.

[58] Bayard Taylor. Central Africa, 105.

[59] Klunzinger. Upper Egypt, 142.

[60] Townsend. Seedsman, 1726, 17.

[61] Bon Jard., 1882, 699.

[62] Woenig. Die Pflanzen in Alt Ægypt, 1886, 217.

[63] Decandolle. Mem. upon the Brassicæ, 1821.

[64] Baillon. Hist. of Plants, III., 222.

sorts. It seems to be the *Boeotion* of Theophrastus,[65] who described this form as the least acid, and of a rotund figure, and with small leaves; the *Syriacan* of Columella [66] and of Pliny.[67] This sort does not appear to have received extensive distribution northward during the middle ages, as they find but little mention in the earlier botanies. In 1586 Lyte [68] says they are not very common in Brabant; but they are figured in two varieties by Gerarde. I am disposed to put here the *Raphanus vulgaris* of Tragus, 1552, which he describes as round, small, and common in Germany. Bontius [69] in 1658 mentions them in Java, and in 1837 Bojer [70] describes them as grown at the Mauritius. In 1842 Speede [71] gives an India name, *gol moolee*, for the red and white kinds.

Raphanus orbiculatus. Round radish. Ger., 1597, 184.
Scarlet French Turnip. Vilm., 1885, 485.
Small Early White Turnip. Vilm., 1885, 487.
Radicula sativa minor. Small garden radish. Ger., 1597, 183.
White olive-shaped. Vilm., 1885, 490.
Olive-shaped Scarlet. Vilm., 1885, 488.

Raphanus sativus Mill.[72]

The root of this class is long, nearly cylindrical, diminishing insensibly to a point at the extremity. It is now the common garden radish. It has a variety of colors from the white to the red, and is noteworthy from the transparency of the flesh. It may well be the *radicula* of Columella,[73] and the *Algidense* of Pliny,[74] which he describes as having a long and translucent root. It is

[65] Theophrastus, Lib. VII., c. 4.
[66] Columella, Lib. X., c. 114; Lib. XI., c. 3.
[67] Pliny, Lib. XIX., c. 26.
[68] Lyte. Dodoens, 1586, 687.
[69] Bontius. Ind. Orient., 1658, 12.
[70] Bojer. Hort. Maur., 1837, 16.
[71] Speede. Ind. Handb. of Gard., 1842, 147.
[72] Baillon. Hist. of Pl., III., 222.
[73] Columella, Lib. IV., c. 8; Lib. XI., c. 2.
[74] Pliny, Lib. XIX., c. 26.

not described in England by Lyte nor by Gerarde; it is described as in the gardens of Aleppo in 1573–5.[75] In 1658 Bontius[69] calls them in Java *Dutch radish;* in 1837 Bojer[70] names them in the Mauritius, and in 1842 Speede[71] gives an Indian name, *lumbee moolee.*

Raphanus minor purpureus. Lob. Obs., 1576, 99; ic., 1591, I., 201.

Raphanus longus. Cam. Epit., 1586, 224.

Raphanus purpureus minor. Lobel., Lugd., 1587, 636.

Radicula sativa minor. Dod., 1616, 676.

Raphanus corynthia. Bodaeus, 1644, 769.

Long Scarlet. Vilm., 1885, 490.

Long White Vienna. Vilm., 1885, 492.

Raphanus albus longus.

The long white late and large radishes I do not recognize in the ancient writings, unless it be the reference by Pliny[74] to the size; some radishes, he says, are the size of a boy infant, and Dalechamp[76] says that such can be seen in his day in Thuringia and Erfordia. In Japan, so says Kizo Tamari,[77] a Japanese commissioner to the New Orleans Exposition of 1886, the radishes are mostly cylindrical, fusiform or club-shaped, from one-fourth of an inch to over a foot in diameter, from six inches to over a yard in length, and J. Morrow[78] says that at Lew Chew radishes often grow between two and three feet long, and more than twelve inches in circumference. In 1604 Acosta[79] writes that he had seen in the Indies "redish rootes as bigge as a man's arme, very tender and of good taste." These radishes are probably mentioned by Albertus Magnus[80] in the 13th century, who says that the *radix* are very large roots of a pyramidal figure, with a somewhat sharp savor, but not that of *raphanus;* they are planted in

[75] Gronovius. Orient., 81.

[76] Hist. Gen., Lugd., 1587, 634.

[77] Am. Hort., Sept., 1886, 9.

[78] Morrow. Perry's Japan, II., 16.

[79] Acosta. Hist. of the Ind., 1604, 261.

[80] Albertus Magnus. De Veg., Jessen Ed., 1867, 556, 645.

gardens. They seem to have been the principal kind in northern Europe a few centuries later, and are said by Lyte[81] in 1586 to be the common radish of England. In 1790 Loureiro[82] describes them as cultivated in China and Cochin China, and they seem to be the form described by Kaempfer[83] in Japan, in 1712. The radishes figured by the early botanists enable us to connect very closely with modern varieties.

(*a.*)
Raphanus longus. Trag., 1552, 732.
Raphanus. Matth., 1558, 241; 1570, 332.
Raphanus sive radix. Pin., 1561, 145.
Raphanus magnus. Lob. Obs., 1576, 99; ic., 1591, I., 201.
Raphanus alba. Cam. Epit., 1586, 223.
Raphanus sativus Matthiol. Lugd., 1587, 635.
Raphanus sive radicula sativa. Dod., 1616, 676.
White Strasbourg. Vilm., 1885, 494
(*b.*)
Raphanus II. Matth., 1570, 332; 1598, 349.
Raphanus secundus Matthiol. Lugd., 1587, 635.
Laon long gray Winter. Vilm., 1885, 496.
(*c.*)
Raphanus. Matth., 1558, 241; 1570, 332.
Raphanus sive radix. Pin., 1561, 145.
Raphanus sativus matthiolus. Lugd., 1587, 635.
Radice. Cast. Dur., 1617, 383.
White Spanish Winter. Vilm., 1885, 497.
(*d.*)
Raphanus sativus. Garden Radish. Ger., 1597, 183.
Large White Russian. Vilm., 1885, 497.

Raphanus niger vulgaris A. P. DC.

This radish does not seem to have been mentioned by the ancients. In 1586 Lyte says, The radish with a black root has

[81] Lyte. Dodoens, 1586, 687.
[82] Loureiro. Fl. Cochin Ch.; 1790, 396.
[83] Kaempfer. Amoen., 1712, 822.

of late years been brought into England, and now beginnith to be common.

Raphanus nigra. Cam. epit., 1586, 223.
Raphanus sive radicula sativa nigra. Dod., 1616, 676.
Raffano longo. Cast. Dur., 1617, ap.
Long-rooted Black Spanish. Bryant, 1783, 40.
Long Black Spanish Winter. Vilm., 1885, 496.

Raphanus niger rotundus A. P. DC.

This is a turnip-rooted or round form of a black radish, usually included among winter sorts.

Raphanus pyriformis. Ger., 1597, 184.
Raphanus I. Matth., 1598, 349.
Large Purple Winter. Vilm., 1885, 495.

There is another form of black radish figured in the early botanies, of quite a distinct appearance. It answers suggestively to the description by Vilmorin of the Radis de Mahon, a long red radish, exceedingly distinct, growing in part above ground, and peculiar to some districts in southern France and to the Balearic isles. I connect it with diffidence with the following:

Raphanus niger. Lob. ic., 1591, I., 202.
Radice selvatica. Cast. Dur., 1617, 384.
Raphanus niger. Bod., 1644, 770.
Radis de Mahon. Vilm., 1885, 499.

Theophrastus mentions the Corinthian sort as having full foliage, and the root, unlike other radishes, growing partly out of the earth, but the Long Normandy answers to this description as well as the Mahon.

The radish was known to Turner[84] in England in 1536 under the name of *radyce*. It was noted in Mexico in the sixteenth century by Peter Martyr,[85] by Benzoni[86] in Hayti in 1565, and was under cultivation in Massachusetts about 1629.[87]

[84] Turner. Libellus, 1537.

[85] Peter Martyr. Eden's Hist. of Trav., 1577.

[86] Benzoni. Hist. of the New World. Smyth Trans., 1857.

[86] Wood. New Eng. Prosp., 1st Ed., II.

[87] Vilmorin. Les Pl. Pot., 518.

The radish is called in France, *radis, petite rave, rave* ;ni Germany, *radies* ; in Flanders and Holland, *radijs* ; in Denmark, *haveroeddike* ; in Italy, *ravanello, radice* ; in Spain, *rabanito* ; in Portugal, *rabao, rabanite* ;[87] in Norway, *reddik* ;[88] in Greece, *rapania*.[89]

In Arabic, *figl*,[90] *fioyl, bokel* ; in Bengal, *moola* ;[91] in Burma, *mung-la* ;[89] in Ceylon, *rabu* ;[91] in Egypt, *fidjel* ;[89] in Hindustani, *moola, muli* ;[91] in India, *moolee* ;[92] in Japan, *daikon* ; in Malay, *lobak* ; in Sanscrit, *mooluka* ; in Tamil, *moolinghie* ; in Telinga, *mullangi*.[91]

Raphanus caudatus L.

This radish has pods often a foot or more in length, and these find use as a vegetable. It became known to Linnæus in 1764 ;[93] it reached England from Java about 1816,[94] and was described by Burr[95] as an American kitchen plant in 1863. According to Firminger[96] the plant has but lately come into cultivation in India, and there bears pods often three feet in length. These pods make excellent pickles.

It was at first called in England *tree radish from Java*,[94] in India, *rat-tailed radish*,[96] the name it now holds in the United States ; by Burr,[95] in 1863, *Madras radish.*

There are a number of radishes now known whose type requires further study before presentation. Such are the Chinese winter radishes, whose roots are swollen more at the base than at the summit, the oil-bearing radish, etc. The first of these is in general cultivation in Japan.

88 Schubeler. Culturpf., 107.

89 Pickering. Ch. Hist., 473.

90 Delile. Fl. Æg. Ill.

91 Birdwood. Veg. Prod. of Bomb., 138.

92 Speede. Ind. Handb. of Gard.. 147.

93 Miller's Dict., 1807.

94 Gard. Chron., 1866, 779.

95 Burr. Field and Gard. Veg., 384.

96 Firminger. Gard. in Ind., 149.

RAMPION. *Campanula rapunculus* L.

The roots and leaves of Rampion are eaten in salads. It is recorded as in gardens by Pena and Lobel [98] in 1570, and is figured by Tragus [97] in 1552, Lobel [99] in 1576, as well as by other writers of this period as an improved root. In 1726 Townsend [100] says it is but in few gardens in England, and Bryant [101] in 1783 says it is much cultivated in France, but in England is now little regarded. It is recorded in American gardens in 1806, 1819, 1821, etc. As late as 1877 an English writer says rampion is a desirable addition to winter salads.[102]

Rampion is called in France, *raiponce, baton de Jacob, cheveux d'eveque, petite raiponce de careme, pied-de-sauterelle, rampon, rave sauvage;* in Germany, *rapunzel;* in Flanders and Holland, *rapunsel;* in Italy, *raperonzolo, raponzolo;* in Spain, *reponche, raponchigo;* in Portugal, *rapunculo.*[103]

RED CABBAGE. *Brassica oleracea* (*capitata*) *rubra* L.

The first certain mention I find of this cabbage is in 1570, in Pena & Lobel's Adversaria,[104] and figures are given by Gerarde, 1597,[105] Matthiolus, 1598,[106] Dodonaeus, 1616,[107] and J. Bauhin, 1651.[108] These figures are all of the spherical headed type. In 1636,[109] Ray notices the variability in the colors upon which a number of our seedsmen's varieties are founded. The oblong or the pointed headed types which now occur, I cannot trace.

97 Tragus. De Stirp., 1552, 725.

98 Pena and Lobel. Adv., 1570, 130.

99 Lobel. Obs., 1576, 178.

100 Townsend, 1726, 23.

101 Bryant. Fl. Diet, 1783, 27.

102 E. Hobday. Cottage Gard., 1877, 113.

103 Vilmorin. Les Pl. Pot., 537.

104 Pena and Lobel. Adv., 1570, 91.

105 Gerarde. Herbal., 1597, 246.

106 Matthiolus. Ed. of 1598, 367.

107 Dodonæus Pemgt., 1616, p. 621.

108 J. Bauhin. Hist., 1651, II., 831.

109 Ray. Hist. 1686, 795.

The solidity of the head and the perfectness of the form in this class of cabbage indicate long culture and a remote origin. In England they have never attained much standing for general use,[110] and as in this country are principally grown for pickling.

The *Red Cabbage* is called in France, *chou pommerouge;* in Germany, *rote kopfkohl;* in Italy, *cavalo rosso;* in Dutch, *rood kool;* in Spain, *berza colorado;* [111] in India, *lal kobee.*[112]

The synonymy seems to be as follows:

I.

Brassica convoluta and arcte occlusa rubro colore. Adv., 1570, 91.

B. Lacuturria. Lyte's Dod., 1586, 637.

B. Capitata rubra. Bauh. Phytopin., 1596, 176; Pin., 1623, III.; Ger. Herb., 1597, 246; J. Bauh., Hist., 1651, II., 831; Ray, Hist., 1686, 621.

B. rubra capitata. Dod. Pempt., 1616, 621.

Chou pomme rouge. Tourn., Inst., 1719, 219.

Red cabbage, spherical headed forms.

II.

Dark red early pointed headed. Vilm., Alb. de Cliches, 1885.

New Garfield Pickeler. Tillinghast Cat., 1884.

RHUBARB. *Rheum* sp.

The rhubarb as a vegetable is in more repute in American and English gardens than in France, and is now widely distributed and much grown in American gardens. It is, however, of recent introduction; the first of its kind being only known about 1608, and the first reference I find to its growth as a vegetable in England being in 1778, although its culture probably dates somewhat earlier. It appeared in American gardens before 1806, but in 1821 Cobbett says he had never seen it in America. In 1822,

110 J. W. Gent. Syst. Hort., 1683, 203. Townsend. Seedsman, 1726, 27, etc.

111 McIntosh. Book of the Gard., II., 116.

112 Speede. Ind. Handb. of Gard., 114.

J. Lowell, in the Massachusetts Agricultural Repository, says that thirty years ago we were strangers to the rhubarb, which has now become an article of extensive culture. R. Manning, Secretary of the Massachusetts Horticultural Society, says that in 1844 it was acquiring that popularity which now renders it indispensable. In 1863 Burr describes ten varieties for American gardens. I am not sufficiently acquainted with this genus to refer our cultivated sorts to their proper species, but I cannot agree with Vilmorin in referring them all to one species, *Rheum hybridum*. I present the species, in order of introduction, to which our cultivated rhubarbs have been referred by authors.

Rheum rhaponticum L.

A native of Southern Siberia and the region of the Volga, it was introduced to Europe about 1608, and cultivated at Padua by Prosper Alpinus, and seeds from this source were planted by Parkinson in England about 1640 or before.[113] There is no reference, however, to its use as a vegetable by Alpinus[114] in 1627, nor by Ray[115] in 1686, although the latter refers to the acid stalks being more grateful than that of garden sorrel. In 1778, however, Mawe[116] says its young stalks in spring, being cut and peeled, are used for tarts. In 1806 M'Mahon[117] mentions it in American gardens, and says the footstalks are very frequently used, and much esteemed for tarts and pies. In 1733 Bryant[118] describes the footstalks as two feet long, and thicker than a man's finger at the base.

Rheum undulatum L.

To this species have been referred garden varieties with a red stalk. It is said to be a native of China, and introduced to Europe in 1734. It is mentioned in American seed catalogues of

[113] Pharmacographia, 1879, 500.

[114] Alpinus. De Exot., 1627, 188.

[115] Ray. Hist., 1686, 170.

[116] Mawe. Gard., 1778.

[117] M'Mahon. Am. Gard. Cal., 1806, 205.

[118] Bryant. Fl. Dict., 1783, 67.

1828. Decaisne and Naudin [119] say it is grown in gardens, but is not as esteemed as is the Victoria rhubarb. In 1840 [120] *Buck's* and *Elford* rhubarb are referred to as originating from this species. In 1882, a variety called *Tartreum* [121] announced in France as new, and highly praised, is referred here.

Rheum palmatum L.

Its habitat ascribed to China neighboring to Tartary, it first reached Europe in 1763 [122] or 1758.[120] The footstalks are much smaller than those of other kinds, hence it is not in general cultivation.[120] It is yet rare in France, although this species is superior in quality, as it is quite tender.[123]

Rheum compactum L.

A native of Tartary and China, it became first known in Europe in 1758. In the Bon Jardinier of 1882 it is said to be the species principally grown in France as a vegetable, but Vilmorin [124] refers his varieties to *Rheum hybridum*, but these it is to be remarked are English.

Rheum hybridum L.

This is the species to which our largest and finest varieties are usually referred. It is of uncertain origin. It is first noticed in England in 1773 or 1774,[125] but it did not come into use as a culinary plant until about 1827. In 1829 a footstalk was noted as sixteen inches long.[126] The Victoria rhubarb of our gardens is referred to this species. In 1877 a stalk was exhibited at

[119] Decaisne & Naudin. Man., IV., 190.

[120] Vegetable Substances, 1840, 205.

[121] Bon. Jard., 1882, 565.

[122] Noisette. Man., 1826, 297.

[123] Bon Jard., 1882, 706.

[124] Vilmorin. Les. Pl. Pot., 1883, 538.

[125] Miller's Dict., 1807.

[126] Rhind. Veg. King., 1857, 309.

Boston which weighed 2 lbs. 2½ ozs., and in 1882, twelve stalks which weighed forty pounds.[127]

Rheum ribes L.

This plant is considered by Linnaeus[128] to be the *Ribes arebum* of Rauwolf, who traveled in the Orient in 1573-5, and who found it in the region of the Lebanon,[129] and its habitat is also given as Eastern Persia. Decaisne and Naudin[130] refer to it as grown in gardens in France, but not as esteemed as the *R. hybridum*, while the Bon Jardinier of 1882 says it is reported the best as an esculent, and is greatly praised.

Rheum australe, Don.

This species, which is the *R. emodi*, Wal., is said by Loudon[131] to have an excellent flavor, somewhat resembling that of apples, and excellent for a late crop, and the Bon Jardinier of 1882 says the petioles are longer and more esteemed than those of other species. On the contrary Burr[132] in 1863 says the leaf stalks, although attaining an immense size, are unfit for use on account of their purgative properties, but the plant is sometimes cultivated for its leaves, often a yard in diameter, which are useful for covering baskets containing vegetables or fruit.

The wild rhubarb about Cabul is blanched for use as a vegetable, and under the name of *rewash* is brought to the market. Gravel is piled about the sprout as it breaks from the earth, and by continuing the process the plant is forced to grow to the height of 18 or 20 inches. Another process is to cover the sprout with an earthen jar, and the sprout then curls itself spirally within the jar, and becomes quite white, crisp and free from fibre. It is eaten in its raw state with either salt or sugar, and makes a favorite preserve[133].

127 Mass. Hort. Soc. Trans., 1887, III., 1882, 244.

128 Linnaeus Sp., 2d ed., 532.

129 Gronovius. Orient., 49.

130 Decaisne & Naudin. Man., IV., 190.

131 Loudon. Hort., 1860, 688.

132 Burr. Field and Gard. Veg., 1863, 631.

133 Harlan. U. S. Pat. Off. Rept., 1861, 528.

Rhubarb is called in France, *lubarbe ;* in Germany, *rhabarber ;* in Flanders and Holland, *rabarber ;* in Denmark, *rhabarber ;* in Italy, *rabarbaro, robarbaro ;* in Spain and Portugal, *ruibarbo* [134].

ROCAMBOLE. *Allium sorodoprasum* L.

The culture of Rocambole is limited in this country, but in southern Europe the Genoese bring vast quantities to Provence under the name of *ail rouge* [135]. It is not of ancient culture, as it cannot be recognized in the plants of the ancient Greek and Roman authors, and finds no mention of garden cultivation by the early botanists. It is the Scorodoprasum II. of Clusius [136], 1601, the Allii genus, ophioscorodon dictum quibusdam, of J. Bauhin [137], 1651, but no indications of culture in either case. Ray [138], in 1688, does not refer to its cultivation in England. In 1726 however, Townsend [139] says it is " mightily in request"; in 1783 Bryant [140] classes it with edibles. In France, however, it was grown by Quintyne [141] in 1690. It is enumerated for American gardens in 1806 [142]. No varieties are mentioned.

Rocambole is called in France, *ail rocambole, ail rouge, ail d'Espane, eschalote d'Espagne, rocambole ;* in Germany, *roccambol;* in Denmark *rokambol ;* in Italy *aglio d'Indi ;* In Portugal, *alho de Hespana.*[143] It 1698 in England it was called *Spanish-Garlick*, and in 1826 *rockambole.*

[134] Vilmorin. Les. Pl. Pot., 538.
[135] Bon Jard. 1882, 414.
[136] Clusius. Hist., 1601, 190.
[137] J. Bauhin. 1651, II., 559.
[138] Ray. Hist., 1688, II., 1120.
[139] Townsend. Seedsman, 1726, 25.
[140] Bryant. Fl. Diet, 1788, 23.
[141] Quintyne. Comp. Gard., 1704, 223.
[142] McMahon. Am. Gard. Cal., 1806, 190.
[143] Vilmorin. Les. Pl. Pot., 3.

THE KNEES OF THE *TAXODIUM DISTICHUM.*

BY ROBERT H. LAMBORN.

IN a "Preliminary Notice of Some of the Results of the United States Geological Survey Examination of Swamp Land," by Prof. N. S. Shaler, of Cambridge, Mass. (*Science*, March 8, '89), it is stated as the result of observations begun in 1874, while engaged on the Kentucky State Survey, and continued and recorded in various publications by the author, official and otherwise, extending up to date, that the occurrence of knees on the *Taxodium distichum* is explained "through a need of an aeration of the sap which is denied the roots that are under water." He also ascribed the enlarged base of the tree to the same need of aeration of the sap, and discards as disproven the hypothesis that such enlarged or buttressed base is useful to the tree as securing greater resistance to storms.

In the Memoir (by the same author) of the Museum of Comparative Anatomy (Harvard College, 1887), the theory of aeration is still more distinctly enunciated. "The failure of knees to develop when they grow on high ground; the development of the knees when the roots are in permanent water; the rise of the knees above permanent water level, and to a height varying with that level, and, finally, the destruction of the trees whenever the level of permanent water rises above the tops of the knees,—these facts incontestably show that there is some necessary connection between them and the function of the roots, when the latter are permanently submerged." "It seems likely, therefore, that some process connected with the exposure of the sap to the air takes place in these protuberances." Following these official publications, a communication was presented to the Academy of Natural Sciences, of Philadelphia (pp. 67 to 69, Proceedings, April, 1889), by Prof. Wilson, of the University of Penna., in which the result of certain observations made by him in Florida in 1885-6 are given. He records a careful series of experiments made by dig-

ging up young trees, by cultivating the plant from the seed, and by observing exposed root systems. He finds that "if the tree requires, from inundation or other causes, more aerating surface than can be readily or rapidly produced by young and growing roots, then either the whole upper surface of the root in question may become more active and rapid in its growth, or the places of growth may be limited to certain definite points"—so knees are produced. He continues: "I do not propose at this time to discuss the function of these knees, further than to say that their *location* and *occurrence* indicate beyond a doubt that they are for purposes of aerating the plant."

In the monthly publication of the Pennsylvania Forestry Association (*Forest Leaves*, December, 1889), in a careful article on the Taxodium, Prof. Wilson, referring to Prof. Shaler's work, again adverts to the knees, and says: "From recent experiments made by the writer at the department of Biology, it has been demonstrated that the knees are organs produced by the roots for the purpose of taking in a greater supply of oxygen than could otherwise be had from the surrounding water.

This theory which finds in the knees and swollen boles of the cypress the sole function of conveying something advantageous from the atmosphere to the sap of the tree during periods of submergence, seems to have been entertained as early as 1847, when Dr. Dickinson and Andrew Brown read before the Association of American Geologists, in Boston, a study of "The Cypress timber of Mississippi and Louisiana." In this interesting illustrated article of eight pages in *Silliman's Journal* for January, 1848, they say, "The cone-shaped, leafless protuberances, sometimes ten feet high, growing from the interlacing roots in a dense forest, resemble in all but their color the crowded stalagmites in some enormous cavern. By means of these protuberances the roots, though totally submerged, have a communication with the atmosphere. We suggest," they say, "that this function is fulfilled by the knees." When this communication is cut off by the annual overflow rising above the tops of the knees, the swollen base carries the similar structure of the roots up the bole of the tree to an elevation sufficient to reach the atmospheric air.

Until recently this aerating theory seems to have met with no opposition, and it bid fair to become the generally accepted explanation for these strange vegetable growths, which travelers in our Southern states so often observe and mention.

A paper in *Garden and Forest*, the result of careful studies in Florida, which we now reproduce, will be found interesting because it explains the same phenomena upon an entirely different assumption. It is as follows:

From time to time, during and since my first visit to our southern tier of states in 1876, I have examined, sketched and photographed the roots of the Deciduous Cypress—the *Taxodium distichum* of Richard. I was attracted to the tree because of the singular beauty of its forms and foliage, and by the unusual boldness with which it raises its great, gray, smooth column, sometimes over a hundred feet perpendicularly, above and upon what an engineer would pronounce a most dangerous foundation—loose submerged sand, the saturated morass or the soft alluvium of low river margins.[1] But notwithstanding this seeming insecurity, I have never found a healthy cypress that had fallen before the fierce hurricanes that sweep through the southern forest-lands.[2]

The surprising and characteristic temerity of the tree is accompanied by another striking peculiarity—it almost invariably, in soft soils, throws upward from the upper surface of its roots conspicuous protuberances that are known as "Cypress knees."

These seemingly abnormal growths have attracted much attention, and for more than half a century have furnished an enigma to the so-

[1] It is a pleasure to follow Bartram in his enthusiastic burst of admiration for this tree as he writes of it in east Florida 116 years ago: "This Cypress is in the first order of North American trees. Its majestic stature is surprising. On approaching it we are struck with a kind of awe at beholding the stateliness of its trunk, lifting its cumbrous top toward the skies and casting a wide shade on the ground as a dark intervening cloud, which from time to time excludes the rays of the sun. The delicacy of its color and the texture of its leaves exceed everything in vegetation. . . . Prodigious buttresses branch from the trunk on every side, each of which terminates underground in a very large, strong, serpentine root, which strikes off and branches every way just under the surface of the earth, and from these roots grow woody cones, called Cypress knees, four, five and six feet high, and from six to eighteen inches and two feet in diameter at the base.

[2] Elliot ("Bot. of S. C. and Ga.," 1824, p. 643) says: "This Cypress resists the violence of our autumnal gales better than any otner of our forest trees." By my friend, Dr. J. S. Newberry, whose extended geological labors have led him to examine many widely separated Cypress-bearing regions in the Mississippi Valley and elsewhere, I am assured that he remembers no instance of the overthrow by the wind of a living *T. distichum*.

lution of which scientific travelers have addressed themselves. Michaux made a careful study of the Cypresses, and in his "Sylva," published in 1819, says: "The roots are charged with protuberances eighteen to twenty-four inches high.[3] These protuberances are always hollow, and smooth on the surface, and are covered with a reddish bark, like the roots, which they resemble in softness of wood. They exhibit no sign of vegetation, and I have never succeeded in obtaining shoots by wounding the surface and covering it with earth. They are peculiar to the Cypress, and begin to appear when it is twenty to twenty-five feet high." Michaux adds, with the frankness natural to a scientific mind, "No cause can be assigned for their existence." Hoopes says in his "Book of Evergreens" (1868): "No apparent function for which the knees are adapted has been ascertained." And Veitch, who seems to have studied the protuberances in England, gives in his "Manual" (1881, p. 216) a picture of a tree growing at Ilesworth, surrounded by scores of knees, and says: "They are peculiar to this Cypress, and no cause has been assigned for their existence." That the question continued in this unilluminated condition until recently was shown in 1882, when I had the privilege of visiting, in company with the highest botanical authorities,—Dr. Gray, Thomas Meehan, John H. Redfield, John Ball, Professor Carruthers and others,—the classic collection of trees planted by William Bartram on the borders of the Schuylkill. There we examined a fine Cypress and the knees it had produced. Dr. Gray then told me that the use to the tree of the knees was unknown. I remarked that they might be a means of raising a point on the root above surrounding water to the end that a leaf-bearing shoot could readily sprout therefrom. To this suggestion he made the same statement made by Michaux and above recorded. Unaware that the subject had been so thoroughly investigated, I have since that period examined hundreds of living "knees" in southern swamps, and found upon them no trace of bud, leaf or sprout, except where some seed may have lodged in a decayed or depressed portion of the surface and there taken root.

In 1887 I had the good fortune to find a number of Cypress trees under such unusual conditions that their aforetime subterranean anatomy could be studied without obstruction, and I reached a conclusion respecting the use to the tree of the protuberances which I have retained in my note-book, awaiting an opportunity to make some further illus-

[3]I have ridden among them in central Florida, in temporarily dry upland basins, where they arose to my breast as I sat upon the saddle, and were not less than seven feet in height above the root.

PLATE XII.

Taxodium distichum.

trative sketches before placing it before botanists. Some recent publications on the subject by widely and favorably known authors have, however, ascribed to the Cypress-knees the sole function of aërating the sap of the parent tree, and this idea bids fair to become embedded in botanical literature. Therefore this communication comes to you earlier than I had purposed sending it.

Stretches of the shore of Lake Monroe, in central Florida, are closely set with large Cypress-trees. They grow in various kinds of bottom, —clay, mud and sand. Those of which I shall here speak stood in sand so loose that when the level of the water was lowered the waves readily washed it away and carried it into the depths of the lake. Some four vertical feet of the root-system were thus finely exposed. After several days spent in examining a score or more large trees that had been thus denuded I became convinced that the most important function of the Cypress knee is to stiffen and strengthen the root, in order that a great tree may anchor itself safely in a yielding material.

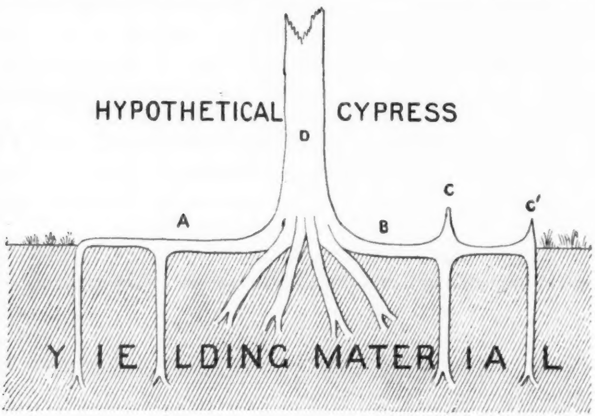
The word "anchor" is indeed an apt one here, for the living root, curved to its work and firmly grasping the sandy bottom, suggests vividly the best bower-anchor that a man-of-war may throw into similar loose sands, when threatened by the very atmospheric forces that the Taxodium has been fitting itself to resist since Tertiary times.[4]

Truly a most admirable and economical arrangement to stiffen and strengthen the connection between the shank of the anchor and its fluke is this knee, and usually in the living anchor the fluke branches or broadens as it descends, so that its effectiveness is greatly increased, like the sailor's anchor of many flukes, or the "mushroom anchor" that he may have learned to depend upon where the bottom is softest.

The accompanying picture (see page 20) is from a photograph that I made in 1887 of the lower portion of a tree that rises some seventy feet above the shore line of Lake Monroe. The original surface of the sand was near the level of the higher roots. The picture shows the manner in which this peculiar species throws out horizontal roots from its conical (usually hollow) buttressed base. At different distances from this conical base these horizontal roots project strong branches more or less perpendicularly into the earth. When such perpendicular "flukes" branch from the main horizontal "shank," it will be seen,

[4] My friend Thomas Meehan informs me [December 17th, 1889] that he has "observed a case where the interior hollow makes an annual layer of bark equally with the exterior," and he is of the opinion that "it is by the decay of the outer layer of this inside course of bark after several years that the knob becomes hollow." If this habit is general it is an admirable means of forming and of preserving undecayed, at the smallest cost to the tree, a living elastic strengthener at the forking of the roots.

there is formed a large knob, which is the "knee" under discussion. This knee, when fully developed, is generally hollow, comparatively soft, gnarled, and very difficult to rupture, so that it has the quality of a spring that becomes more rigid as it is extended or compressed out of its normal shape. When in a hurricane the great tree rocks back and forth on its base, and with its immense leverage pulls upon this odd-shaped wooden anchor, instead of straightening out in the soft material, as an ordinary root might, thus allowing the tree to lean over and add its weight to the destructive force of the storm, it grips the sand as the bower-anchor would do, and resists every motion. The elasticity at the point of junction allows one after another of the perpendicular flukes attached to the same shank to come into effective action, so that



From "Garden and Forest." Copyright, 1890, by the "Garden and Forest Pub. Co."

before being drawn from the sand or ruptured the combined flukes present an enormous resistance.

The above drawing I have made for the purpose of simplifying the discussion. It shows a hypothetical Cypress with two roots of the same length and diameter—one with knees, the other without them. The superior strength of the stiffened root would seem sufficiently evident; but, with the view of obtaining the judgment of a mind thoroughly trained in questions of this nature, I submitted the drawing to my friend, Charles Macdonald, late Director of the American Society of Civil Engineers, whose eye has been accustomed to estimating the value of strains in structures by an active experience of twenty-five

years, and who has just finished the largest drawbridge in America, at New London. Mr. Macdonald agreed with me that the root B, which is trussed with the knees C and C′, would very largely exceed in capacity for holding the tree firmly in yielding material the root A, which is similar but destitute of knees. This greatly increased security against destruction by storms is, I think, a sufficient advantage to account for the existence and maintenance of an organ that draws so slightly upon the vitality of the plant.

It is proper to record here another observation that may explain the existence of the elevated, narrow point which the knee sometimes develops, and which rises higher than the curved growth that would be necessary to secure the maximum resistance to compression and extension. The home of the Cypress is in broad, level river-margins subject to periodic overflow, where hundreds of square miles become covered with a shallow bed of slowly moving water, or in basin-like depressions, sometimes of vast extent, where from time to time water rises above the level of the horizontal roots. Then these stake-like protuberances, rising into and through the current formed by the drainage or by the winds, catch and hold around the roots of the parent trees many thousand pounds of "plant food" in the form of reeds and grass, or small twigs among which dead leaves become entangled. The tree that exclusively possesses this source of nutrition is at an advantage over all others in the neighborhood, and the higher these attenuated "drift-catchers" rise in the stream, the more drift will they arrest, for the highest stratum of water is richest in float. The theory that some distinguished writers have suggested that the knee is a factor in the aëration of the sap, and that the tree's death is prevented by such aëration taking place in the upper portion of the knee during periods of high water, would seem to need careful experimental confirmation. Where nature forms an organ whose purpose is to preserve the life of the individual, she takes special care to adapt such organ to the function it is depended upon to perform. In this case the rough, dry bark of the knee offers a most imperfect means of access for the oxygen or other gases of the atmosphere to the interior vessels of the plant, and instead of presenting broad surfaces of permeable membrane, formed for transmitting elastic fluids, at its upper extremity the protuberance becomes more narrow and presents less surface as it rises, so that when during periods of high water the life of the tree is most jeopardized, the life-saving organ attains its minimum capacity. In the presence of this manifest want of adaptation it also seems important for the acceptance of the aërating theory that some one should experimentally

show that the aërating organ of the Cypress really aërates to an extent sufficient to make it of material advantage to the plant.[5]

It was long ago observed that no knees are developed when the tree grows in upland upon a firm bottom, in which ordinary simple roots can obtain in the ordinary way the hold necessary to resist overturning forces, and where there is no stratum of water to transport food. So conservative is nature, that she reverts to an original or adopts a simpler form of root even in a single generation if the need for the more complicated arrangement ceases to exist.

Finally, I may perhaps be permitted to add an observation regarding the roots of other trees that trench upon the same soils affected by the Cypress and often take advantage of the anchors it sets so boldly in treacherous bottoms. These trees project their cable-like, flexible roots in every direction horizontally, interlacing continually until a fabric is woven on the surface of the soft earth like the tangled web of a gigantic basket. Out of this close wicker-work, firmly attached to it, and dependent for their support upon its integrity, rise the tree trunks. Thus slowly, and by a community of growth and action, a structure is formed that supplies for each tree a means of resisting the storms. Such communities of trees, provided with ordinary roots, advance against and overcome enemies where singly they would perish in the conflict. The cyclone, the loose sand, the morass—these are the enemies they contend with, as it were, in unbroken phalanx, shoulder to shoulder, their shields locked, their spears bristling against the foe; but the graceful plumed Cypress, the knight-errant of the sylvan host, bearing with him his trusty anchor—the emblem of Hope—goes forth alone and defiant, afar from his fellows, scorning the methods of his vassals, and planting himself boldly amid a waste of waters, where no other tree dare venture, stands, age after age, erect, isolated, but ever ready to do battle with the elements. Twenty centuries of driving rain and snow and fierce hurricane beat upon his towering form, and yet he stands there, the stern, gray and solitary sentinel of the morass, clinging to the quaking earth with the grasp of Hercules, to whom men were building temples when his wardenship began.

[5] The "Chemical Theory" of the Cypress knee seems to be but a revival of the elaborate hypothesis of Dickinson and Brown, published in their memoir on *T. distichum* in the *American Journal of Science and Arts*, in January, 1848. These industrious observers discard the "Mechanical Theory" entirely, and consider both the spongy knees, and, strangely enough, even the spreading base of the tree, as organs of communication with the air, forgetful that the successful and most celebrated lighthouse in the world—the Eddystone—was avowedly modeled after a similar spreading tree-base for the purpose of withstanding the storm shocks of the English Channel. By means of a curious drawing they show how the swollen portions of the base rise "to the top of the highest water level, which must, in some instances, attain an elevation of at least twenty-five feet;" thus continuing the functions and the structure of the knees, "up the body of the tree to the atmosphere."

FROM BRUTE TO MAN.

BY CHARLES MORRIS.

THAT man as an animal is an offspring of the lower life kingdom, none who are familiar with the facts of science now think of denying. Despite the indignant protest against this idea when promulgated by Darwin less than thirty years ago, it is now generally accepted by all those who have fully considered the evidence, and who therefore are alone competent to decide upon it. But that man as a thinking being has descended from the lower animals is a very different matter, and is by no means proved. Regarding the origin of man's intellect, there is much difference of opinion, even among scientists, and such a radical evolutionist as Alfred Russel Wallace finds here a yawning gap in the line of descent, and believes that the intellect of man is a direct gift from the realm of spirits. His explanation, it is true, is more difficult than the difficulty itself. It cannot justly be called a hypothesis, for a hypothesis should have some facts to give it warrant, and this has none. That man's mind cannot be explained on the principle of natural selection alone we may, with Wallace, admit. But it certainly would have been better had he on his part more fully considered the possibilities of use and effort, and other natural agencies, before dragging in the angels to bridge the chasm.

That man's intellect at its lowest level is not different in kind from the brute intellect at its highest level Romanes has satisfactorily shown. His evidence, indeed, is superabundant. Controversy on this subject is too apt to be based on the difference between the intellect of the brute and that of enlightened man. Yet the mental gap between the latter and the lowest savage is quite as great as that between the savage and the brute. From the intellect of the animal to that of enlightened man the distance is enormous, yet throughout its whole extent, with a single exception, can be traced intermediate steps of mental development

This exception is the interval between the anthropoid ape and the primitive savage. This is the only gap that remains open in the kingdom of the mind,—the one important lost chapter from the story of mental evolution. It is acknowledged by every well-informed scientist that man's body came up from below. Its links of association with the lower animals are too many and too significant to admit of any other theory. Supernaturalism, therefore, has taken its last stand upon man's mind, and claims that here at least the line of descent is a broken one, and that the gap could not have been filled without a direct interposition from the realm of spirit.

This view of the case is not likely to be accepted as final. Science has bridged with facts so many chasms in the kingdom of nature, that it will scarcely be ready to admit, certainly not till the case has been more thoroughly investigated, that here is a chasm which cannot be bridged, and must be leaped. And yet the known facts that bear upon the question are stubborn things to explain on the evolution theory. If, for instance, we examine the existing conditions of ape and savage intellect no evidence of any active evolution can be discovered. However the anthropoid apes gained their mental acuteness, there is nothing to show that it is increasing. The same may be said of the lowest savages. They are mentally stagnant. The indications are that their intellectual progress for thousands of years in the past has been almost nothing. Yet if man is the descendant of an anthropoid ape there must have been an extraordinary degree of mental development between the one state and the other to produce the great increase in size of brain and activity of intellect. Under the present conditions of imperceptible progress, the whole tertiary period of geology, and perhaps much of the secondary period, would be needed to fill the gap. Yet no such extensive interval can be admitted, and if we seek to deduce man's mind from the ape mind we must be able to show that influences existed calculated to produce a much more rapid mental evolution than now can be perceived in either ape or savage.

Man has changed but little physically since he became man, and perhaps changed little during the period in which he was

becoming man. Could we behold the species of ape which, in the opinion of evolutionists, was his ancestor, we should probably be able to discover no important differences in form. The change has been in the brain, not in the body. The transforming influences acted upon the organ of the mind, not upon the organs of physical life. The brain has yielded to these forces, not by varying in form, but by increasing in size, and by a special expansion of that portion of it devoted to intellectual activity. This great increase in the size of the brain, with the accompanying remarkable unfoldment of the mental powers, certainly indicated the action of very vigorous and long-continued transforming influences; which, if we may judge from the mental stagnation of the present ape and savage, no longer exist.

It is true that the mental organism may be far more plastic than the body, and that no time relations between the development of the intellect and of the physical structure can be drawn. Transformation, under influences of equal potency, may possibly be produced more rapidly in the one case than in the other. An extraordinary development has taken place in the human intellect within a few thousands or tens of thousands of years, yielding the difference that now exists between the cultivated European and the debased savage, and which perhaps equals that between the latter and the ape. If, therefore, it can be shown that influences were at work upon original man as powerful as those that have produced civilization, we shall have done something towards showing how the ape brain may, in a comparatively limited period, have become the brain of man.

The leading causes of the development of civilized man are not at all difficult to discover. Undoubtedly the most potent among them was the influence of warfare, the struggle between man and man on the one hand, and between man and the conditions of soil and climate in the colder latitudes on the other hand. More recently competition in commerce and industry has taken the place of the warlike struggle for existence, and the contest for wealth and position is continuing the effect which the contest for life produced. Hostility between man and nature, and between man and man, has for ages been invigorating the

human intellect, replacing the dull of brain and slow of thought by the quick-witted, energetic, and intelligent, and we may safely look upon this as the most active agent in the unfoldment of civilization.

Was the development from ape to human intellect due to a similar conflict? In the tropics, the home of the savage, war between man and nature scarcely exists, and war between man and man is in its primitive stage. Yet here, as elsewhere, it has much to do with such mental unfoldment as exists. Mastery in warfare is due to superior mental resources, which are gradually gained through the exigencies of conflict, and are shown in greater shrewdnesss or cunning, superior ability in leadership, and the invention of more destructive weapons. War acts vigorously on men's minds, peace acts sluggishly; and the whole story of mankind tells us that intellectual evolution has been due in great part to the destruction in war of the mentally weaker, the preservation of the more energetic and able, and the effect of conflict in producing intellectual activity. But no organized warfare or alert conflict with nature can be perceived in the lowest existing savages. This powerful agent of intellectual development is certainly not at present exerting much influence upon them; they accept the world as they find it, without question or revolt, and their thoughts and habits are as unchangeable as the laws of the Medes and Persians.

But that this stagnancy has always prevailed may well be doubted. The position of the savage is to-day very different from what it was ten or twenty thousand years ago. Then he was dominant upon the earth, the undisputed lord of the kingdom of life. Now new lords of life have come, who are pressing in upon him on every side, preventing his expansion, hampering his activities, and gradually crowding him off the earth. What powers of development primitive man may have possessed can hardly, therefore, be determined from a study of the existing savage, and to gain any solution of the problem we must consider the position of primitive man.

As we have said, the lower savages and the anthropoid apes are at present alike mentally stagnant, while the mental interval

between them is very great. But primitive man differed from the lower animals in one important particular. He was lord and master of the animal kingdom, the dominant being in the world of life. He had no rival in this lordship. None of the herbivora, and none of the carnivora, in any full sense, have ever possessed a similar mastery. The large carnivora are dominant only over the weaker herbivora. So far as we know, the only animal which, except in self-defence, will assail the large carnivora, is the gorilla. This powerful ape is the only creature, except man, of which the lion seems afraid. It does not attack it, however, from any desire for mastery, but simply to drive away a dangerous neighbor.

Man stands alone in his relation to the lower animals He is lord of them all. Savages everywhere are aggressive against, and are feared and avoided by, the largest and strongest beasts of their region. This hostility does not come from the wish to drive away an enemy. It is the desire for food or the instinct of control that moves the savage hunter. He feels, and prides himself on, his lordship. Man does not fight defensively, like the gorilla, but offensively, and whatever be his position in relation to his fellow-man, he admits no equal in the world below him.

This lordship was not gained without a struggle, and that a severe and protracted one. The animal kingdom did not submit supinely to man's mastery. The war must have been long and bitter, however fixed and settled the relations now seem. Rest has followed victory. The animal world is now submissive to man, or in dread of his strength and resources, and the strain upon his mental powers has ceased. But there is certainly reason to believe that men's intellectual progress was due to warlike struggles alike in the primitive and in the historic epoch, the former being a conflict with animals, the latter with man.

We cannot describe at length this primitive hostility. It will suffice to say that it must have been attended with a somewhat rapid mental progress, probably greatly in excess of that which we now perceive in apes and lower man. For the battle was fought with the mind, not with the body. That is to say, man did not depend on hereditary instincts and his natural weapons

of claws and teeth for victory, but brought his mental resources into play. Cunning, caution, boldness where necessary, close observation, variation in modes of attack and defence to suit varying circumstances, are hostile methods of purely mental origin. They are not peculiar to man; many of the lower animals employ them, though none to such an extent as man. But the use of other than the natural weapons is nearly peculiar to man. Some of the monkeys occasionally and imperfectly employ missiles, but man alone has become aware of their great utility, and employs them constantly and skilfully. By the use of artificial implements of warfare his powers were enormously increased, and the steps of progress in his subordination of the lower animals were doubtless marked out by his invention of more and more efficient weapons.

We take it for granted that the animal world did not submit without a struggle, and a protracted one. Step by step, through many centuries of conflict, were the larger animals subdued. It was man's mind, not his body, that subdued them. Physically they were his equals or superiors. His superiority lay in his mental resources, and his victory was due solely to his mental superiority. The effect of the conflict, therefore, bore principally upon his mind, and its organ, the brain, very little upon the body; and when we consider the extent of the achievement we cannot be surprised at the result. Such an advantage, if gained by any of the lower animals through variation of physical structure alone, could not but have produced radical and extraordinary changes in size, strength, and utility of natural weapons. In man the influences of variation were exerted upon the brain alone, and the decided increase in size and activity of this organ does not seem too great for the magnitude of the result. The conflict ended, man settled down to quiet consciousness of victory, but with a much larger brain, and greatly superior mental powers than at the beginning of the struggle. This brain and the higher mentality it indicated enabled him to hold the position he had gained, but there was no special further strain upon his powers, and he simply held his own until a new era of war, now between man and man, or between man and cold and stubborn nature,

called again upon the resources of the mind, and a new era of intellectual evolution began. It is quite possible, as we have said, that the strain in the former case was equal to that in the latter.

Not every animal is adapted by nature to such an evolution. Nearly every animal would be prevented from it by physical disadvantages. Even the anthropoid apes lack certain essential conditions of structure and habits, though favored by the formation of their hands, and their power of grasping and using weapons. But of all animals, the species from which man descended seems to have been the best adapted, and far the most likely, to become the ancestor of a thinking being. For the mental evolution of man was due not only to his struggle for mastery, but also to special advantages which he possessed in the physical structure and the social relations of his ape ancestor. Let us consider the former of these. We know that the ape family are fruit-eaters, and that trees are their natural habitat. But the larger apes manifest an inclination to descend to the earth, probably from their weight rendering a continual life in trees none too agreeable. The largest of them, the gorilla, dwells almost normally on the ground, and it is quite probable that this was the case with man's ancestor. On the ground apes have to make certain changes in their method of locomotion. In the trees they move in a quadrupedal or in a semi-bipedal attitude, by crawling along the limbs, or by walking along the lower and clasping higher limbs with their hands. On the ground either a quadrupedal, a bipedal, or an intermediate motion must be assumed. The baboons, whose fore and hind limbs are nearly equal in length, have become quadrupeds. The three principal species of anthropoid apes, in each of which the fore limbs are of considerable length, have adopted an intermediate mode of motion, swinging their bodies between their hands. The gibbon alone walks in an erect attitude, its very long arms enabling it to use its hands in walking without bending its body. All these animals are essentially quadrupeds, inasmuch as they use all four limbs in locomotion. The gibbon alone is somewhat inclined to walk as a biped, but not when moving swiftly.

Man is structurally different from all these. His arms are shorter as compared with his legs than in any of the existing large apes. It would be impossible for him to walk in the swinging manner of these apes, or by aiding himself with his hands like the gibbon. Quadrupedal motion on hands and feet would be almost equally difficult for him. If his ancestor was like him in this respect, as was undoubtedly the case, then on descending to the ground it must have been forced to walk on its feet alone, from the much greater difficulty, if not the impossibility, of the other modes of motion.

If man's ancestor, however, became a biped through this necessity, it at once assumed a position of remarkable advantage, becoming the only species among the higher animals that did not have to use all four of its limbs in locomotion. His arms and hands were freed for other purposes, and the grasping powers of the hands added immensely to the advantages which this gave. In fact, there can be no question that man owes his supremacy in the animal world to the possession of two limbs which were free from duty as walking organs and could be used fully for attack and defence, and to the grasping power of his hands, which rendered easy and natural the employment of weapons. To this must be added the mental development which all known anthropoid apes possess. These marked advantages at once changed his relation to the lower world of animals. Flight was no longer necessary to safety. He was able to meet much larger animals on equal ground. He was already, like all the apes, mentally acute, observing, and capable of foreseeing and providing for contingencies. As his power of walking erect became easy and natural, and the adaptation of his arms and hands to the use of weapons grew more definite, his standing in the animal kingdom essentially changed; fear and flight ended, so far as animal foes were concerned, retreat ceased, attack began, his mental acumen was called into active play, and the great battle for mastery of which we have spoken came fully into play.

Still another essential element in this development was the social habit of man's ancestor. If we may judge from the conditions of existing savages, the man-ape was a more social animal

than any of the existing anthropoids. The orang and the gorilla are not sociable to any important extent. The chimpanzee is somewhat more so. The indications are that man's ancestor was social in a higher sense than any of these, and employed the principle of mutual aid in a greater degree. It is scarcely necessary to speak of the advantage this would give in the struggle with animals. This advantage is patent. But there is one important result of close social relations of the utmost importance in this connection,—that of education. All social animals educate one another, either with or without design. Anything of importance learned by one member of the group is quickly imparted to all members, and the more rapidly the better their methods of communication and the more complete their system of mutual aid. The lower monkeys teach their young, and indicate to one another anything of importance. There is no doubt that any new and useful weapon or method of assault or defence devised by any member of such a group would become quickly and permanently the property of all the members, and would constitute an important aid in mental development. A long succession of such ideas or inventions, gained by single bright members of evolving mankind, and taught to the others, must have played a highly useful part in the progress from apehood to manhood.

Socialism has been an important requisite of mental evolution throughout the animal kingdom. The highly social ants and bees have raised themselves mentally far beyond all the other insects. The social beavers show a remarkable mental ability as compared with the other rodents. It is, indeed, the communal rather than the simply social animals that have made these great steps of mental progress, those whose labor is devoted solely to the good of the community, and who work in concert for the advantage of each and all. To what extent man was communal in his developing stage it is impossible to say, but the general communism of barbarism may well have been an outgrowth of a primitive condition. There is reason to believe that the individualism which now prevails is of late origin, and was not a characteristic of original man.

One further agency was necessary to man's development—that he should become carnivorous. The apes are fruit-eaters, and lack the native fierceness and the aggressive disposition of the flesh-eating animals. Doubtless man's ancestor was a fruit-eater, but new habits of life probably accustomed him to a mixed fruit and flesh diet at an early period, and the quest of animals for food must have led him to wider excursions and more active enterprise than in the case of any of his frugivorous kindred. Here was an agency calculated to bring him into new scenes and novel relations to nature, and thus greatly to increase the strain upon his faculties and the consequent activity of his mind.

If man came from the ape, it seems certainly very probable that these were the channels of his coming, these the adaptations, the methods, and the exigencies through which a frugivorous ape became an omnivorous man, with a brain like that of the ape in form but greatly developed in size, and faculties like those of the ape in quality, but immensely developed in width and height. From being the equal of the animals he became lord of the animals, their peer perhaps in body, their monarch in mind.[1]

[1] The views presented in this paper are not offered as original. The argument from the social habits of man has been advanced by myself in a previous paper in the NATURALIST, while as for the general subject of the influence of intelligence on human advancement, it has been dealt with by Prof. E. D. Cope in papers entitled "The Method of Creation of Organic Types," "The Hypothesis of Evolution," "The Review of the Modern Doctrine of Evolution," and others, which may be found in his work entitled "Origin of the Fittest." The influence of Use and Effort, as agents in Evolution, has been dealt with by various American writers. The doctrine of Selection through the Struggle for Existence, in fact, covers all that has been said above, and the only novelty claimed is the particular application of this doctrine to the struggle of man for dominion over the world of brutes, and the influence of this struggle on the growth of the brain and the development of intelligence. This view, so far as the writer knows, has not been advanced before.

RECORD OF AMERICAN ZOOLOGY.

BY J. S. KINGSLEY.

IT is the intention to catalogue here in systematic order all papers relating to the Zoology of North America, beginning with the year 1889. To the title and reference will be added such notes upon the contents of the papers as will make the record more valuable to the student. An asterisk indicates that the paper has not been seen by the recorder. Authors are requested to send copies of their papers to J. S. Kingsley, Lincoln, Nebraska.

GENERAL.

WILSON, H. V.—On the Breeding Seasons of Marine Animals in the Bahamas. J. H. U. Circ., VIII., p. 38.—Sponges, Gorgonids, Corals, Annelids. Chiton, *Aplysia*, *Anolis*, *Gonodactylus*.

WILSON, H. V.—Report as Bruce Fellow of the Johns Hopkins University. J. H. U. Circ., VIII., p. 40, 1889.—Account of work at Bahamas, including notice of sense organs in Hoplophora.

HERRICK, F. H.—Days and Nights by the Sea. AM. NAT., XXIII., p. 406. 1889.

STEARNS, R. E. C.—Instances of the Effects of Musical Sounds on Animals. AM. NAT., XXIV., p. 22. 1890.

HEILPRIN, ANGELO.—The Bermuda Islands: A Contribution to the Physical History and Zoology of the Somers Archipelago, [Etc.] Philadelphia, 1889.—Reprints from the Proceedings of the Academy of Natural Sciences of Philadelphia.

PACKARD, A. S.—Cave Fauna of North America; with Remarks on the anatomy of the brain and origin of the blind species. Memoirs Nation. Acad. Sci., Vol. IV., p. 1. 1889.—Vide Infra.

PROTOZOA.

LEIDY, JOSEPH.—On several Gregarines and a singular mode of conjugation of one of them. Proc. Phila. Acad., 1889, p. 9. —Describes *Gregarina philica* from *Nyctobates pennsylvanicus*, *G. actinotus* from *Scolopocryptops sexspinosus*, *G. megacephela*

from *Cermatia forceps*, *G. microcephala* from *Hoplocephla bicornis*. The paper is reproduced in *Journal de Micrographie*, Nov., 1889.

RYDER, J. A.—The Polar Differentiation of *Volvox* and the Specialization of possible Sense Organs. AM. NAT., XXIII., p. 218, 1889. (See Proc. Phila. Acad., 1889, p. 138.)

KELLICOTT, D. S.—Intestinal Parasitic Infusoria of Frogs. *Microscope*, IX., p. 46, 1889.—Presence of *Nyctotherus cordiformis*.

S———, H. M.—A Note on *Difflugia urceolata*. *Microscope*, IX., p. 307. 1889.—Difflugia leaving its shell.

LATHAM, V. DA L.—Short Notes in Practical Biology.—Amoeba. *Am. Mo. Micros. Jour.*, X., p. 151.—Laboratory work; nothing new.

HARGITT, C. W.—Methods of Mounting Infusoria. *Am. Mo. Micros. Jour.*, X., p. 183. 1889.—Kill by corrosive sublimate or Lang's fluid, dehydrate by alcohol, and mount in balsam.

SPONGES.

LEIDY, JOSEPH.—The boring sponge Cliona. Proc. Acad. N. S. Philadelphia, 1889, p. 70.—Describes supposed new species, *C. phallica*, from Florida, and gives resumé of known facts.

CŒLENTERATA.

MCMURRICH, J. PLAYFAIR.—A contribution to the Actinology of the Bermudas. Proc. Phila. Acad., 1889, p. 102, Pls. VI., VII. —Anatomical Notes on *Aiptasia* sp., *Condylactis passiflora*, *Oulactis fasicculata* (nov.), *Diplactis* (nov.) *bermudensis* (nov.), *Zoanthus flos-maris*, *Mammillifera tuberculata*, *Corticifera ocillata*, *C. glaveola*, and *Gemmaria rusei*.

MCMURRICH, J. PLAYFAIR.—The Actinaria of the Bahama Islands, W. I. *Jour. Morph.*, III., p. 1 (see AM. NAT., XXIV., p. 80). An elaborate paper upon the structure of *Aiptasia annulata*, *A. tagetes*, *Condylactis passiflora*, *Bunodes tæniatus*, *Aulactinia stelloides* (nov.), *Lebrunea néglecta*, *Discosoma anemone*, *Rhoductis sancti-thomæ*, *Heteranthus floridus*, *Phymanthus crucifer*, *Oulactis flosculifera*, *Zoanthus sociatus*, *Gemmaria isolata* (nov.), and *Corticifera flava*.

McMurrich, J. Playfair.—List of Actinaria found at New Providence, Bahama Islands. J. H. U. Circ., VIII., p. 30, 1889.

McMurrich, J. Playfair.—On the occurrence of an Edwardsia stage in the free-swimming embryo of a Hexactinian. J. H. U. Circ., VIII., p. 31, 1889.

Wilson, H. V.—On the Occasional Presence of a Mouth and Anus in the Actinozoa. J. H. U. Circ., VIII., p. 37.—Closure of Mouth of *Cereactis bahamensis* in the middle.

Morgan, T. H.—Notice of Dr. H. V. Wilson's paper on the Development of *Manicina areolata.* J. H. U. Circ., VIII., p. 39, 1889.

Fewkes, J. W.—On a Few Californian Medusæ. Am. Nat., XXIII., p. 591, 1889.

Fewkes, J. W.—Physalia in the Bay of Fundy. Am. Nat., XXIII., p. 821, 1889.

Fewkes, J. W.—Emission of a Colored Fluid as a Possible Means of Protection Resorted to by Medusæ. *Microscope*, IX., p. 65, 1889.

McMurrich, J. P.—Note on the Structure and Systematic Position of *Lebrunea neglecta.* *Zool. Anz.*, XII., p. 38, 1889.

Valentine, H. E.—An Observation on the Common Hydra. *Microscope*, IX., p. 374, 1889.

ECHINODERMS.

Ives, J. E.—Variations in *Ophiura panamensis* and *Ophiura teres.* Proc. Phila. Acad., 1889, p. 76.

Edwards, B. L.—Notes on the Embryology of *Mulleria agassizii.* J. H. U. Circ., VIII., p. 37, 1889 (see Am. Nat., XX., p. 845).

Hodge, C. F.—A Study of the Oyster Beds of Long Island Sound, with Reference to the Ravages of Starfish. J. H. U. Circ., VIII., p. 102, 1889.

Fewkes, J. W.—Excavating habits of our Common Sea-Urchin. Am. Nat., XXIII., p. 728, 1889.

Fewkes, J. W.—On Excavations made by Sea-Urchins. Am. Nat., XXIV., p. 1, 1890.

PLATHELMINTHES.

Packard, A. S.—The Cave Fauna of North America. Mem. Nat. Acad. Sci., IV., 1889.—Describes *Vortex* (?) *cavicolus* and *Dendrocœlum percœcum.*

NEMATODA.

Bullock, Edward A.—Ova of *Trichocephalus dispar* in the liver of Rat. *Am. Mo. Micro. Jour.*, X., p. 193, 1889.

Mark, E. L.—Trichinæ in Swine. Ann. Rep. Mass. State Board of Health for 1888, p. 113. 1889.—Results of examinations of 4186 hogs.

ANNELIDS.

Whitman, C. O.—Some new factsabout the Hirudini. *Jour. Morph.*, II., p. 586.—A preliminary paper largely devoted to sense organs.

Chaney, L. W.—Histology of the Earth-worm. *Microscope,* IX., p. 196. Plate. 1889.—Nothing new.

Beddard, F. E.—Note upon the green cells in the integument of *Æolosoma tenebrarum.* Proc. Zool. Soc., London, 1889, p. 51.—In foot-note gives notes on Cragin's species of *Æolosoma.*

PROSOPYGII.

Stokes, A. C.—The Statoblasts of our Fresh-water Polyzoa. *Microscope,* IX., p. 257, 1889.—A popular account with keys to Statoblasts and to genera of fresh-water Polyzoa.

Andrews, E. A.—Reproductive organ of *Phascolosoma gouldii. Zool. Anzeiger,* XII., p. 140, 1889.—Reproductive organs fimbriated bands, running from nerve cord along posterior retractors. Attempts at artificial impregnation unsuccessful.

MOLLUSCS.

Pilsbry, Henry A.—New and little known American Molluscs. Proc. Phila. Acad., 1889, p. 81, 3 Plates.—Describes as new *Holospira elizabethæ* from S. W. Mexico, *Pœcilozonites reinianus* var. *goodei* from Bermuda, *Bithynella æquicostata* from Florida, *Amnicola peracuta* from Texas, *Sphærium* (Limsima)

singleyi from Texas. Notes were given on synonomy and distribution of *Helix* (*Microphysa*) *hypolepta*, *Zonites dallianus*, *Zonites singleyanus*, *Pœcilozonites bermudiensis*, and *Hydrobia monroensis*.

Peck, J. T.—On the Anatomy and Histology of *Cymbuliopsis calceola*. J. H. U. Circ., VIII., p. 32, 1889.—Preliminary account.

Watase, S.—On a new phenomenon of cleavage in the ovum of the Cephalopod. J. H. U. Circ., VIII., p. 33.—Preliminary account of segmentation in *Loligo pealei*.

Hodge, C. F.—A study of the oyster beds of Long Island Sound with reference to the ravages of starfish. J. H. U. Circ., VIII., p. 102, 1889.

Ryder, John A.—The Byssus of the Young of the Common Clam. Am. Nat., XXIII., p. 65, 1889.

Ryder, John A.—Notes on the Development of *Ampullaria depressa*. Am. Nat., XXIII., p. 735, 1889.

Pilsbry, H. A.—The radula in Rhipidoglossate Mollusca. Proc. Phila. Acad., 1889, p. 136.

CRUSTACEA.

Leidy, Joseph.—A parasitic copepod. Proc. Phila. Acad., 1889, p. 95.—Describes as new *Chalimus tenuis* from *Leptocephalus*.

Brooks, W. K. and Herrick, F. H.—A preliminary abstract of researches on the life history of Stenopus. J. H. U. Circ., VIII., p. 29, 1889.

Hay, O. P. and W. P.—A contribution to the knowledge of the genus Branchipus. Am. Nat., XXIII., p. 91, 1889.

Kingsley, J. S.—The development of *Crangon vulgaris*. Third paper. Bull. Essex Inst., XXI., p. 1, 3 plates, 1889. (See Am. Nat., XXIII., p. 737.)

Andrews, E. A.—Autotomy in the Crab. Am. Nat., XXIV., p. 138, 1890.

Herrick, F. H.—The development of the compound eye of Alpheus. *Zool. Anzeiger*, XII., p. 164, 1889.—Eye arises as thickening of ectoderm, thickened by immigration and delamination; differentiates into two layers: 1. Outer retinogen. 2.

Gangliogen. No invaginations occur. Ommatidum consists of two corneagen cells, four vitrellæ, and seven retinular cells. No nerve fibres are found in crystallin cones.

OSBORN, H. L—Elementary Histological Studies of the Crayfish. XII. The Eye, *Am. Mo. Micro. Jour.*, X., p. 25, 1889. XIII. The Eye, l. c., p. 147, 1889.

CHANEY, L. W.—Some habits of the Crayfish. *Am. Mo. Micro. Jour.*, X., p. 86, 1889.—Eating, locomotion, oviposition, molting.

PACKARD, A. S.—The Cave Fauna of North America, etc. Mem. Nat. Acad. Science, IV., 1889.—Describes *Cauloxenus stygius, Canthocamptus cavernarum, Cæcidotæa stygia, C. nickajacensis, Crangonyx vitreus, C. packardi, C. antennatus, C. mucronatus, C. lucifugus, Cambarus pellucidus, C. hamulatus;* and gives notes on brain and optic organs of Cæcidotæa and Cambarus.

ARACHNIDA.

IVES, J. E.—*Linguatula diesingii* from the Sooty Mangubey. Proc. Phila. Acad., 1889, p. 31.

LEIDY, JOSEPH.—Note on Gonyliptes and Solpuga, l.c., p. 45. *Gonyleptis curvipes* from Chili and *Solpuga cubæ* from Florida.

MARX, GEORGE.—A contribution to the knowledge of the spider fauna of the Bermuda Islands, l. c., p. 98, 4 Pl. Catalogues twelve species as collected, one of which, *Lycosa atlantica*, is new.

PATTEN, WM.—Segmental sense organs of Arthropoids. *Jour. Morphol.*, II., p. 600. A preliminary paper giving an account of eyes and other sense organs of Limulus, spiders and scorpions.

WATASE, S.—Structure and development of the eyes of Limulus. J. H. U. Circ., VIII., p. 34, 1889. (See AM. NAT., XXIV., p. 81.) Preliminary communication.

JACKSON, C. Q.—The *Acarus folliculorum* in the human skin. *Microscope*, IX., p. 97, 1889.—Nothing new.

EMERTON, J. H.—Pairing of *Xysticus triguttatus. Psyche*, V., p. 169, 1889.

PACKARD, A. S.—The Cave Fauna of North America. Mem. Nat. Acad. Sci., IV., 1889.—Describes *Rhyncholophus caverna-*

rum n, *Bryiobia?* (or *Penthalæus?*) *meyerensis* n, *Laelaps?* (or *Holostaspis?*) *wyandottensis* n, *L.* (= *Iphis?*) *cavernicola* n, *Gamasus* (or *Hypoaspis*) *troglodytes* n, *G. stygius* n, *Damæus* (=*Delba*) *bulbipedata* n, *Oribata alata* n, *Uropoda lucifugus* n, *Sejus? sanborni n, Obisium cavicola, Chthonius packardi, C. cæcus, Phalangodes robusta, Ph. flavescens, Ph. armata, Ph. spinifera, Phlegmacera cavicolens, Nemastoma troglodytes, N. inops,* and reprints Emerton's descriptions of cave Araneina (Am. Nat., IX., p. 278, 1875.)

MYRIAPODA.

Bollman, C. H.—Notes on a small collection of Myriapods from the Bermuda Islands. Proc. Phila. Acad., 1889, p. 127. Four species catalogued, *Spirobolus heilprini* as new.

Rondeau, Kate.—Note on the feeding habits of *Cermatia forceps.* Am. Nat., XXIV., p. 31, 1890.

Packard, A. S.—The Cave Fauna of America [etc.] Mem. Nat. Acad. Sci., IV., 1889.—Describes *Lysiopetalum lactarium, Pseudotremia cavernarum, Scoterpes copei, Zygonopus whitei, Cumbala annulata,* and gives notes on brain and sense organs of Pseudotremia.

EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

THE increase in the number of original investigators in science during the last few years in the United States, is a gratifying indication of intellectual progress. Progress in science and philosophy means increase in positive knowledge. This means light for the mind, as well as comfort and health for the body, both now and in time to come To know whence we come and whither we tend, is to be prepared for the future as well as for the present. The age demands knowledge, and provision is being gradually made in this country for the producers of it. The time is not far distant, we suspect, when the confusion between the producers and the distributors of knowledge, which is so prevalent, will disappear. Millions are expended for the dissemination of knowledge through the medium of schools and libraries, while small sums only can be obtained for the production of new truth. The increase in the number of producers in science is educating the public mind, and one great need, that of institutions of original research, will be supplied. Professors in universities and colleges who are competent in this work can now only pursue it in leisure moments, and these are often few.

New institutions might be endowed with this object in view, since few of the old ones supply the organization necessary for the successful execution of such work. These might be appropriately associated with universities in the proper localities for purposes of mutual advantage. The increase in the original investigators holds forth a promise of the organization on a true basis of academies of science in our States. Those in existence having commenced by electing as members everybody who can pay the necessary fees, have mostly lost their scientific character, and have sunk into inaction. Little can be done with them, since those into whose hands they have fallen are generally unwilling to adopt the necessary changes. But the times will soon be auspicious for the organization of new bodies, whose membership will be an order of merit, and a recognition of work done.

—WITH this number of the AMERICAN NATURALIST we begin the publication of a serial catalogue of all current articles relating to the fauna of North America. Beginning with the year 1889, we intend as far as possible to place in classified order the titles of all articles which appear in American or European journals relating to the animals of North America and the West Indies. This list will be continued in succeeding numbers, taking up the different groups in ascending order, and then, when the series is complete, returning to the lowest forms again. For 1889 the list will be but little more than a bare catalogue, but beginning with 1890 each title will be followed by such hints at its contents as will make the bibliography more valuable to students.

—THE Marine Biological Laboratory has issued its annual report, in which it makes an exceedingly good showing. The laboratory was crowded last summer, and doubtless will be in the coming session. The trustees appeal for $7,000, enumerating as their chief needs an addition to the building, an increase in the library, and a steam launch. It is to be hoped that the funds will be forthcoming, but it is hardly fair that Boston should furnish them all. Last year both Philadelphia and Chicago furnished more students than Boston. Any subscriptions will be thankfully received by the Secretary, Miss A. D. Philipps, 12 Marlboro street, Boston, Mass.

—THE House of Representatives has passed the bill appropriating about $200,000 for a zoological garden and park within the limits of the City of Washington. The location on Rock Creek is a good one, and under the direction of Mr. W. T. Hornaday, it should be a success. Zoological gardens mean the preservation of such animals as will breed in them from extinction, as well as the instruction of the public. When a good price can be had for living wild animals, people living where they abound will have an interest in preserving them in a wild state. We understand that Professor Frank Baker will be prosector, and will have charge of the department of comparative anatomy in the United States National Museum.

General Notes.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The granite bosses of Morbihan, France, have suffered on their peripheries certain modifications which are ascribed by Barrois[2] to the rate of cooling. These modifications are endomorphous contact effects, but are in no way dependent upon the nature of the surrounding rocks. Two cases are recognized, according as the boundary lines of the bosses correspond with the strike of the enclosing strata or are perpendicular to it. In the first case, the granite, which is a muscovite-biotite rock, possesses on its periphery a zone of granite porphyry, with its phenocrysts arranged in fluidal lines. In the second case, the exterior modification is a fine-grained panidiomorphic aplite. Since the aplite and the porphyry both contain their constituents in idiomorphic grains, the author concludes that the crystallization of the magma yielding these and the granite has gone on progressively, the porphyritic rocks representing an intermediate stage in the formation of a granite from a magma. Schistose granites (gneisses) on the peripheries of these same bosses are aplites and porphyries that have been crushed by mechanical forces and then recemented by the deposition of secondary quartz. Since the gneisses are found only on the south sides of the bosses, the pressure to whose existence they are due is supposed to have come from that direction. ——Mr. Iddings[3] has continued[4] his study of the cause of different structures in rocks produced from the same magma, and has published some of the results of his investigations on the igneous rocks of the Yellowstone Park. This study is concerned principally with the chemical relation of different rocks produced by the cooling of a single molten magma under different conditions. Electric Peak is a neck of diorite cut by numerous dykes of porphyrite. Separated from this by a great fault is Sepulchre Mountain, made up in large part of surface flows of the magma that was extruded through the orifice at Electric Peak. This magma under the conditions surrounding flows formed

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Soc. Geol. du Nord., XV., 1887–8. p. 1.

[3] Bull. Philos. Soc. of Wash., XI., p. 191.

[4] AMERICAN NATURALIST, Dec., 1885, p. 1216, and Aug., 1889, p. 718.

pyroxene and hornblende andesites. The chemical composition of the group of plutonic rocks (represented at Electric Peak) and of the effusive group (at Sepulchre Mountain) is shown to be the same. The structure of their members and their mineral composition, however, are different, and these are shown by the author to be due to the different conditions under which the two groups solidified. The different mineralogical compositions of the various rocks belonging to the same group are likewise shown to be functions of the slight differences which occur in their geological environment. This affects the rate at which the heat escapes from the magma, and also the pressure which is experienced during its crystallization. These in turn affect the efficacy of the mineralizing agents held absorbed by the magma before its solidification. The mineralizing agents in turn show their effect upon the magma in the nature of the minerals separated from it.——Renard[5] announces that the rocks of St. Thomas, in the Antilles, are diorites, containing phenocrysts of hornblende, and diabases. The former contain oligoclase, and the latter bytodnite or anorthite. They are both much altered. The feldspar of the diorites has in most cases changed into epidote and quartz; that of the diabases into epidote, chlorite and calcite.——The same author[6] describes the rocks of the island of Teneriffe as scoriaceous basalts, containing olivine and augite of the first consolidation. The very light color of the latter mineral and its well-marked polysynthetic twinning lamellæ cause it to resemble plagioclase. The lack of plagioclase places the rock in the group of the limburgites. The rocks from the crater of the Cañadas are also basalts, whose olivines are filled with muscovitic inclusions. Large crystals of andesine present in it have an undulous extinction. Augite andesites and trachytes containing sodalite, augite and sanidine with an undulous extinction are also described.——An interesting suite of analyses of some lower Silurian felsites from the southeast of Ireland enables Hatch[7] to divide these rocks into potash, soda, and potash-soda felsites. The first group comprises felsites with few or no phenocrysts, while the second and third groups contain many porphyritic crystals of a striated feldspar in a cryptocrystalline aggregate of orthoclase and quartz. The phenocrysts may be albite or anorthoclase, while the feldspar of the ground-mass is orthoclase. The

[5] Proc. Verb. Soc. Belg. d. Geol., II., 1888, p. 212.

[6] Bull. Soc. Belg. d. Geol. Memoires, XII., 1888, p. 67.

[7] *Geol. Magazine*, Dec., 1889, p. 545.

composition of the three groups may be represented by the following analyses:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	Loss	Sp. Gr.
(1)	70.8	15.1	1.0	.6	.2	1.1	9.1		1.6	2.606
(2)	71.2	16.8	.8	1.5	.8	.9	2.1	4.7	1.5	2.606
(3)	70.6	15.3	.7	1.7	.8	.8	6.1	2.7	.9	2.645

——Wethered[8] has examined the Jurassic pisolite of Cheltenham, England, and has discovered to his surprise that its structure is not concretionary, but that it is of organic origin. The spherules show a nucleus, surrounded by numerous concentric layers of innumerable minute tubuli, produced by an organism similar to *Girvanella.*——The Kentish Rag, from near Maidstone, Eng., contains a large proportion of calcium sulphide, as shown by an analysis made by Mr. Sanford:[9]

SiO_2	$Fe_2O_3.Al_2O$	P_2O_5	CaO	MgO	Alk.	CO_2	SO_3	CaS	Aq
72.051	2.15	.055	12.523	.054	.122	9.984	.647	1.334	.995

——Some of the peculiarities of the numerous dykes cutting the slates and granite in the neighborhood of Kennebunkport, Maine, are mentioned by Mr. Kemp.[10] The rocks forming the dykes are granites, diabases, camptonites, and diabase porphyrites.

New Minerals. — *Redingtonite, knoxvillite, metastibuite* and *nopalite.*—At the hundred and fifty foot level of the Redington Mine, in the Knoxville District, California, is a hydrous chromium sulphate, supposed to be the result of the action of solfataric gases upon chromic iron. The mineral occurs as a finely fibrous mass of a pale purple color, that becomes colorless in the thin section. The fibres are doubly refractive, and have an extinction varying between 13° and 38°. When heated, the mineral turns green without losing all of its water, and then agrees in most of its properties with *copiapite.* The green sulphate consists of rhombic tables with angles of 78° and 120°. They have good cleavages parallel to the base, the prismatic faces and the macropinacoid. The absorption is greatest when the short diagonal of the crystals corresponds with the principal plane of the nicol. The axes of elasticity lie in the oP face—the one parallel to the brachy-axis being the greater. Mr. Becker[11] calls the purple mineral *redingtonite* and the green one

[8] *Geol. Magazine,* May, 1889, p. 197.

[9] Ib. Feb., 1889, p. 73.

[10] *Amer. Geologist,* Mar., 1890, p. 129.

[11] G. F. Becker: Geology of the Quicksilver Deposits of the Pacific Slope. Monographs XIII. Washington, 1888, p. 343.

knoxvillite. A brick-red sulphide of antimony from the filling of a vein in a sinter deposit in the Steamboat Springs District, near the Comstock Lode, Nevada, is named *metastibnite* by the same author. *Napalite*[12] is a dark reddish-brown substance of the consistency of shoemaker's wax occurring at the Phœnix Quicksilver Mine, Pope Valley, California. Its hardness is 2, and specific gravity 1.02. It is brittle. It fuses at 42°–46°, and boils at 300°. When first taken from the ground it is green by reflected light, and garnet by transmitted light. Upon exposure it loses its green fluorescence. The composition of the mineral is supposed to be near C_3H_4. ——*Nesquehonite*[13] is an alteration product of *lansfordite*, the new magnesium compound described by Genth[14] a few months ago. The latter mineral, upon exposure, rapidly changes over into prismatic, orthorhombic crystals, usually arranged in radiating groups. Their axial ratio is $a:b:c = .645:1:.4568$. oP is the plane of the optical axes. The brachy-axis is the acute bisectrix, which is negative. The optical angle $2V_{na} = 53° 5'$. Hardness $= 2.5$, and Sp. Gr. $= 1.83$. The composition of the substance corresponds to $MgCO_3 + 3H_2O$ [$CO_2 = 30.22$; $MgO = 29.22$, $H_2O = 40.32$]. Artificial nesquehonite has been prepared by allowing aqueous solutions of magnesium carbonate containing carbon dioxide to stand undisturbed for some time. The crystals thus obtained present the same features as the natural product. Measurements of the indices of refraction on one of these crystals gave: $\alpha = 1.495$, $\beta = 1.501$, $\gamma = 1.526$. Perfect pseudomorphs of nesquehonite after lansfordite (incrustations and stalactites) were found at the locality from which the latter mineral has been described—Lansford, Schuylkill Co., Pa.——*Natrophilite* is a new member of the triphylite group lately described by Messrs. Brush and Dana[15] from Branchville, Connecticut. The mineral is usually found in masses with a good cleavage, although occasionally grains with an indistinct crystal form are detected. It resembles very closely the lithiophilite ($LiMnPO_4$) discovered by the same authors some time ago, in both its morphological and optical aspects. Its color, however, is a deep wine, resembling the tint of Brazilian topaz. Its most characteristic features are its very brilliant lustre and its easy alteration into a a pale yellow, silky, fibrous substance that covers all its surfaces and

[12] Becker: Ib., p. 372.

[13] Genth and Penfield: *Amer. Jour. Sci.*, Feb., 1890, p. 121.

[14] AMERICAN NATURALIST, April, 1889, p. 261.

[15] *Amer. Jour. Sci.*, March, 1890, p. 205.

penetrates its mass. The composition of natrophilite, as determined by Mr. H. L. Wells, is:

P_2O_5	MnO	FeO	Na_2O	Li_2O	H_2O	Loss
41.03	38.19	3.06	16.79	.19	.43	.81,

essentially $NaMnPO_4$. The new mineral is regarded as but another one of the very interesting substances produced by the alteration of *spodumene* and *lithiophilite*. The *triphylite* group as now known consists of triphylite ($LiFePO_4$), lithiophilite ($LiMmPO_4$), and natrophilite ($NaMnPO_4$), besides many intermediate compounds.——*Rosenbuschite*, *nordenskjoldite*, and *melanocerite* have been described by Brögger[16] from the syenite dykes in the vicinity of the Langesundsfiord, in Southern Norway. The first mineral is found in radial groups composed of monoclinic fibres with cleavages parallel to oP, $\infty P\overline{\infty}$ and $2P\overline{\infty}$. The axial ratio is $a : b : c = 1.1687 : 1 : .9775$. $\beta = 101°$ $47'$. The acute bisectrix is b. The obtuse bisectrix is inclined 36° to c in the acute angle β. Double refraction strong. The mineral is easily fusible, and is decomposed with strong hydrochloric acid. It is light orange gray in color, and is weakly pleochroic with $C > B > A$. Its specific gravity is 3.31 and hardness 5–6. In morphological properties and in composition it is apparently a zirconium *pectolite*.

SiO_2	ZrO_2	TiO_2	Ti_2O_3	Fe_2O_3	La_2O_3. $(DiCE)_2O_3$	MnO	CaO	Na_2O	Loss
31.53	18.69	6.07	1.31	1.15	2.38	1.85	25.38	10.15	.20

——*Nordenskjoldite* is a calcium-tin-borate with the composition [Ca Sn $(BO_3)_2$]:

SnO_2	ZrO_2	CaO	B_2O_3	Loss
53.75	.90	20.45	23.18	1.72

It crystallizes rhombohedrally with $a : c = 1 : .8221$, and is tabular in habit. It is sulphur yellow in color, is transparent, optically negative and strongly doubly refractive. Its hardness is 5½–6 and Sp. Gr. 4.2. *Melanocerite* is also rhombohedral with $a : c = 1 : 1.2554$. It occurs in tabular crystals of a deep brown or black color. Their double refraction is negative, hardness 5–6, and specific gravity 4.129. Chemically the mineral is a complicated compound of the rare earths with silica, tantalum, boron, and fluorine.——*Cohenite* is described by Weinschenck[17] from the meteoric iron of Magura, Hungary. When dissolved in hydrochloric acid the meteor leaves a residue in which little prismatic tin white crystals are discovered. These turn brown when

[16] Geol. För. i. Stockholm Förh., IX., 1887, p. 247. Ref. *Neues Jahrb. f. Min., etc.*, 1889, II., p. 432.

[17] Ann. K. K. Naturh. Hofmus., Wien., IV., 1889, p. 94.

exposed to the air. They are highly magnetic, are brittle, have a hardness of 5.5–6, and a specific gravity of 6.977. When analyzed they yield Fe = 90.19; Ni = 3.08; Co = .61; C = 6.70; P = .08; and traces of Cu and Sn—a composition corresponding to the carbide of iron and nickel $(55Fe. 2NiCo)_3C$.——In addition to the organic compound napalite, referred to above, two others have lately been described; one by Blake[18] from the Uintah Mountains in Wahsatch County, Utah, to which he has given the name *wurtzilite*, and the other by Morrison[19] from the old red sandstone at Craig Well, near Dingwall. The latter is a mineral tar, associated with *albertite*. It is called *elaterite*. Its composition as found by Macadam is C = 81.186; H = 13.372; O., etc., = .4453; N = .127; S. = .862. *Wurtzilite* is a firm, black, solid substance resembling jet. It is found in large, pure, amorphous masses a little heavier than water, and elastic in thin flakes. In thin pieces it is garnet red. Its hardness is 2–3, and specific gravity 1.03. It does not fuse in boiling water, but melts readily in the flame of a candle, when it burns with little smoke. It does not dissolve easily in any of the usual reagents.——Two new minerals to which names have not yet been given by their discoverers have been described respectively by Sjögren[20] and Ussing[21]. Sjögren's mineral occurs in vitreous, transparent, light green tables, associated with *synadelphite*, at the mine Ostra, in Nordmark, Sweden. The tables possess an easy cleavage and a pearly lustre. They are biaxial, with the plane of their optical axes nearly normal to the cleavage plane. The axial angle is small. Before the blowpipe the mineral blackens and fuses with difficulty. In the air it oxidizes and becomes dirty gray or brown. A qualitative examination shows the presence of As, Mn, Zn, and Fe. Ussing's compound is found imbedded in microcline, and associated with aegerine and lithium mica. It forms, small, thick rhombohedral crystals, with $a : c = 1 : 2.1422$. The principal forms present are $0R$, $\frac{1}{8}R$, $\frac{1}{4}R$, R, ∞R,—$2R$,—$\frac{1}{2}R$ and $\infty P2$. The faces are sometimes brilliant, and at others dull. The crystals are yellowish-brown and translucent. They are optically uniaxial and positive. Their specific gravity is 2.07, and hardness 5. In form, they resemble *eudyalite*. Their locality is Kangerdluarsuk, Greenland.

[18] *Eng. and Min. Jour.*, December 21, 1889.

[19] *Min. Mag.*, March, 1889, p. 133.

[20] Ofversigt af Kongl. Vetenskaps-Ak. Förh., Stockholm, 1888, p. 561. Ref. *Neues Jahrb. f. Min., etc.*, 1890, I., p. 24.

[21] Geol. Fören. Förh., X., p. 190, Stockholm. Ref. *Neues. Jahrb. f. Min., etc.*, 1890, I. p. 25.

Miscellaneous.—Perlitic structure, according to Mr. Chapman,[22] may be produced in Canada balsam by heating this substance until it is thick enough to become brittle when cold, and then pouring it upon a roughened glass plate and suddenly immersing in cold water.——Harker[23] ascribes the eyes of pyrite in slate to the displacement of the matrix around pyrite crystals through pressure. Because of its hardness the pyrite resists the pressure. The slate yielding to it breaks away from the crystal along a plane perpendicular to the line of force, and leaves little hollows on both sides of it. The hollows are afterwards filled with quartz. The eyes consist of pyrite, forming a center, imbedded in a lenticular mass of quartz or some other secretionary mineral.——In a book of about two hundred and seventy pages Mr. Merrill[24] publishes a catalogue of the building stones in the collection of the National Museum, and gives a very clear and succinct account of the methods employed in quarrying and finishing the various rocks used in construction.——A very valuable account of the mineral resources of Michigan is given by Mr. Lawton[25] in his annual report as Commissioner of Mineral Statistics of Michigan.——Dick[26] describes a new form of binocular microscope for use in petrographical investigations, made according to his own design. The most important new feature of the instrument is the connection of the two nicols, which may be made to revolve together or separately, at the will of the manipulator.

BOTANY.

Three Suggestions on Botanical Terminology.—So far as I can find there are at least two very marked and interesting phenomena in the physiology of plants which have as yet received no appropriate names by which they may be always recognized and under which they may be discussed. These are—first, the peculiar irritability of twining plants, in view of which, together with their negative geotropism and their asymmetrical nutations, the spiral habit of growth is maintained. From the most recent researches it appears probable that Von Mohl was correct in his early conjecture that some such specific irritability existed in twining plants, and it is proper that this specific irritability

[22] *Geol. Mag.*, Feb., 1890, p. 79.
[23] Ib., Sep., 1889, p. 397.
[24] Rep. Smiths. Institution, 1885–6, Pt. II.
[25] Mines and Mineral Statistics. Lansing, 1889.
[26] *Min. Mag.*, March, 1889, p. 160.

should have its name, and that English writers on the subject should be freed from the necessity of expressing themselves upon it in paraphrases. Unless some better term has been devised or some little-used term should have priority, it is proposed to term the motion of twining plants—so far as that motion is the result of the specific irritability—*dromotropism*, and we can then speak of such twining shoots as dromotropic.

Again, certain very well-known but as yet very poorly understood movements take place during fertilization and conjugation, by means of which antherozoids are directed to the waiting oösphere,—perhaps passing down the long neck of an archegonium ; by which pollen tubes reach the oösphere in the embryo-sac of phanerogamous plants, and in view of which it is possible for the conjugating, motile or resting, sexual cells of zygophytic plants to come in contact with each other through an intervening space of air or water or soil. In the case of the higher cryptogamous plants, where clear differentiation of male and female organs and cells exists, the directive impulse seems to originate in the oösphere itself. Possibly the movement of the antherozoids towards the oösphere—a movement of such great biological importance —should be explained by attributing, as has been done, to the oösphere the power of excreting some chemical compounds which, while of the nature of waste products or excreta, nevertheless exert a stimulative and directive effect upon antherozoids in the near vicinity. So far as I can learn careful experiments to indicate just how far the oösphere can exert this stimulative influence have not yet been made. It would be of the greatest importance to discover through how many millimetres of water, for example, a polypodium antherozoid would find its way to the proper archegonium, but in the present state of the knowledge upon this topic, we cannot speak very accurately. Should the conjecture of a chemical stimulus be the correct one, the whole series of phenomena connected with conjugation and fertilization, to which passing allusion has been made, would possibly be most analogous to the hydrotropic curvatures of roots and shoots in view of which growth takes place from a region less saturated with moisture to one more saturated, or *vice versa*. For evidently if any aromatic excretum is given off from a sexual cell it would be in greater quantity the nearer one came to the originating cell.

Movements, then, of antherozoids and pollen-tubes, since they are clearly irritable movements, might appropriately be termed *gonotropic*, and the movements of the water cells themselves towards the female might be termed *gonotropism*. If it were deemed necessary to dis-

tinguish between the movements of free, locomotive antherozoöids such as those of Marchautia or Aspidium and the curvature of pollen tubes, the name gonotropism could be appropriately reserved for the latter class of movements, while the former might have the name of *gonotaxis*, analogous to phobotaxis—seen in swimming green zoöspores and in chlorophyll bodies of unequal axes. The movements of antherozoöids then might be termed *gonotactic*.

In the case of phanerogams, however, the stimuli which direct the pollen tube do not seem to originate in the oösphere alone, but are apparently sent forth by the *synergidæ* or "co-workers" as well. That the pollen tube should pass between the synergidæ and thus penetrate to the oösphere lying directly behind them, whatever the position of the ovule itself, could scarcely take place unless some stimulus should be sent from the synergidæ. This peculiar habit of the pollen tube, most instructively shown in anatropous or campylotropous ovules, might be explained as due to a repellent influence or stimulus sent from the *synergidæ*, in view of which the pollen tube, growing in the line of least resistance, necessarily must pass between them,—as, for example, to use a rather violent simile, the sailors of ancient days steered between Scylla and Charybdis, avoiding each as far as possible. This irritability of the pollen tube, in view of which it avoids the synergidæ, can scarcely be explained by supposing that stimuli originate in the oösphere alone, for, if this were true, the uniform course of the pollen tube between the synergidæ would not become clear. Neither can it be explained by supposing the synergidæ and oösphere capable of equal gonotropic stimulation, for then the further growth of the pollen tube after reaching a point midway between the three cells at the top of the embryo-sac would become a matter of chance. Apparently then we must consider the synergidæ as cells capable of sending stimuli, probably chemical in nature, either similar to the gonotropic stimuli of the oösphere, but much feebler, or of a nature precisely the reverse of the oösphere stimuli. Concerning the point here suggested there is yet no experimental evidence sufficiently strong to allow more than conjecture. If, however, the conjecture of a specific gonotropic irritability, different in different species of plants, be accepted, the possibility of hybridization depends upon two preliminary coördinations; first, the tissues of the receiving stigma, style and ovary must be such that nutrition and growth of the stranger-pollen is possible; second, gonotropic stimulation of the stranger-pollen must intervene to direct the course of its growth. This makes no account of the act of fertilization itself, but refers merely to externals, if one

might name them so. Evidently the highly specialized requirements of pollen-tubes in the matter of nutrition are properly supplemented by highly specialized specific gonotropic irritabilities. The first is exactly paralleled by the specific nutrition requirements of the various parasitic fungi, which select each their own particular host-plant or animal, but the second is *sui generis*.

When, however, the cells of zygophytic plants find their way to each other, as for example, the zoösphores of Pandosina, or the conjugating cells of Piplocephalus, there is scarcely a localisation of gonotropic irritability in one cell, and of gonotropic stimulation in the other. In such plants we are below the stage of specialization, and the whole act of conjugation is so unlike that of higher plants that a different name might properly enough be given to the peculiar directive influence which each conjugating cell has upon the other. They might truly be considered equally gonotropic and equally capable of stimulation; but for the sake of differentiating between the bisexual movements and the unisexual, it might be well to term the movement shown by either of two similar conjugating gametes gamotropism. That gonotropic irritability is a specialized type, an outgrowth from *gamotrophic*, goes without saying. Both are probably connected with the excretion of certain as yet unclassified chemical compounds, and the progression of the higher from the lower, with accompanying specializations, would open a field of research exceedingly interesting although exceedingly difficult.

Carefully conducted and systematic experiments are needed along two lines, suggested in this brief note upon so fertile a subject: 1st, Experiments to indicate the distance to which specific gonotropic stimuli can be propagated through the surrounding medium; 2d, Experiments to show, by cross-pollenations, the relation between gonotropic irritability and appropriate nutrition upon the growth and direction of pollen-tubes.—CONWAY MACMILLAN, *Univ. of Minn.*

The So-Called Uredospores of Gymnosporangium.—Mr. H. M. Richards has carefully re-investigated the so-called uredospores of *Gymnosporangium clavariæforme,* and finds that Kienitz-Gerloff's conclusions are erroneous. In a recent number of the *Botanical Gazette* Mr. Richards publishes the results of a series of germinations of both forms of spores, viz., the fusiform (teleutospores) and the clavate (the so-called uredospores), and shows that, however much they may differ in form, they certainly present no constant difference in their mode of germination. Under favorable conditions both give rise to the characteristic promycelium bearing sporidia. Under less

favorable conditions variations may arise, *e. g.*, great elongation of the promycelium when grown in an excess of water, or its great shortening when the moisture was insufficient. In the latter case the short promycelial cells readily fall apart, and under favorable conditions grow into hyphæ. Spores of the latter kind Kienitz-Gerloff considered to be uredospores, but Mr. Richards shows conclusively that their peculiar germination is due to special conditions, and that they are therefore to be still regarded as teleutospores.

Hackel's Revision of the Andropogoneæ.—The sixth volume of the "Monographiæ Phanerogamarum" of the De Candolles is a notable work of over seven hundred pages, entirely devoted to a monograph of a single tribe of the great order of the Gramineæ. When one observes that in this book there are descriptions of 420 species, the vastness of the undertaking of the noted author is made evident. At the present rate it will require from five to seven thousand pages in all, or from six to eight or nine additional volumes like the present one.

Hackel divides the tribe Andropogoneæ into five sub-tribes, to which he assigns the thirty genera which he recognizes. The scheme of classification may be made out from the following synopsis:

ANDROPOGONEÆ. Kth. ampl.

Sub-tribe I. Dimerieæ Hack.

Genus 1. *Dimeria* R. Br. Japan, Malay Archipelago, Australia. 12 sp.

Sub-tribe II. Sacchareæ Benth. & Hook.

Genus 2. *Imperata* Cyril. Tropical and Sub-tropical. 5 sp.
" 3. *Miscanthus* Anderss. Asia. 7 sp.
" 4. *Saccharum* Linn. Tropical and Sub-tropical. 12 sp.
" 5. *Erianthus* Michx. Tropical and Temperate. 18 sp.
" 6. *Pollinia* Trin. Tropical Eastern Hemisphere. 29 sp.
" 7. *Spodiopogon* Trin. Eastern Hemisphere. 5 sp.
" 8. *Polytrias* Hack. Java. 1 sp.
" 9. *Pogonatherum* Beauv. Eastern Hemisphere. 2 sp.

Sub-tribe III. Ischæmeæ Hack.

Genus 10. *Apluda* Linn. Tropical Eastern Hemisphere. 1 sp.
" 11. *Ischæmum* Linn. Tropical Eastern Hemisphere. 42 sp.
" 12. *Lophopogon* Hack. India and Australia. 2 sp.
" 13. *Apocopis* Nees. Asia. 2 sp.
" 14. *Eremochloa* Büse. Tropical Asia. 8 sp.
" 15. *Thelepogon* Roth. India and Africa. 1 sp.

Sub-tribe IV. Rottbœllieæ Benth.

Genus 16. *Vossia* Wall. India and Africa.
" 17. *Urelytrum* Hack. Africa. 2 sp.
" 18. *Rhytachne* Desv. Tropical Africa. 4 sp.
" 19. *Rottbœllia* Linn fil. Both Hemispheres. 1 sp.
" 20. *Manisuris* Sw. Both Hemispheres. 1 sp.
" 21. *Opheurus* Gærtn. Eastern Hemisphere. 4 sp.
" 22. *Ratzeburgia* Kunth. Burmah. 1 sp.

Sub-tribe V. Euandropogoneæ Benth.

Genus 23. *Trachypogon* Nees. America, Africa, and Madagascar. 1 sp.
" 24. *Elionurus* Humb. Tropical and Sub-tropical. 15 sp.
" 25. *Arthraxon* Beauv. Eastern Hemisphere. 8 sp.
" 26. *Andropogon* Linn. Both Hemispheres. 193 sp.
" 27. *Cleistachne* Beuth. Tropical Africa. 1 sp.
" 28. *Themeda* Forsk. Eastern Hemisphere. 8 sp.
" 29. *Iseilema* Anderss. India and Australia. 5 sp.
" 30. *Germainia* Bal. & Poit. India and China. 1 sp.

Some of the species are wonderfully complex; for example, *Andropogon sorghum* Brot., which contains two sub-species, *halepensis* and *sativus*; the former with five varieties and seven sub-varieties; while the latter has thirty-seven varieties and twelve sub-varieties.

CHARLES E. BESSEY.

Sachs' History of Botany.[1]—The many readers of the NATURALIST who are familiar with the German edition of Sachs' History of Botany, which appeared in 1875, will be glad to see the work in an English dress. It will at once become much better known to botanical students, for with all our German teaching in the colleges, it is still a fact that books in the English language are read and consulted much more freely by students than when in German. The translation has been so well done in this case that American students may safely take it up in place of the original, expecially as the author has in this made some minor changes.

The work is divided into three "books," the first of which is devoted to the "History of Morphology and Classification," the second

[1] History of Botany (1530-1860), by Julius von Sachs, Professor of Botany in the University of Würtzburg. Authorized translation by Henry E. F. Garnsey, M.A., Fellow, of Magdalen College, Oxford. Revised by Isaac Bayley Balfour, M.A., M.D., F.R.S., Professor of Botany in the University, and Keeper of the Royal Botanic Garden, Edinburg. Oxford: at the Clarendon Press. 1890. Crown 8vo, pp. xvi., 568.

to the "History of Vegetable Anatomy," and the third to the "History of Vegetable Physiology." In treating these topics, the author says in his preface to the English edition: "I purposed to present to the reader a picture of the way in which the first beginnings of scientific study of the vegetable world in the sixteenth century made their appearance in alliance with the culture prevailing at the time, and how gradually, by the intellectual efforts of gifted men, who at first did not even bear the name of botanists, an ever-deepening insight was obtained into the relationship of all plants, one to another, into their outer form and inner organization, and into the vital phenomena or physiological processes dependent on these conditions."

In this preface several sentences attract the attention of the reader. For example: "I would desire that whoever reads what I have written on Charles Darwin in the present work should consider that it contains a large infusion of youthful enthusiasm, still remaining from the year 1859, when the 'Origin of Species' delivered us from the unlucky dogma of constancy. Darwin's later writings have not inspired me with like feeling. So has it been with regard to Nägeli."—CHARLES E. BESSEY.

Photographs of Dr. Parry.—I feel certain that I am obliging many botanists by stating that good photographs of the late Dr. C. C. Parry, the well-known botanist, may be obtained of Jarvis White & Co., of Davenport, Iowa, for twenty-five cents each. Wishing to place such a photograph in my gallery of botanists, I made inquiries, with the result given.—CHARLES E. BESSEY.

ZOOLOGY.

A New Actinian.—Dr. H. V. Wilson describes (Studies J. H. Univ., IV., No. 6) a new Actinian from the Bahamas, under the name *Hoplophoria coralligens*. It belongs in the family Antheadæ, and is noticeable from the fact that only six pairs of mesenteries reach the œsophagus, and in the position of four marginal sacs, which are highly developed stinging organs. In regard to Hertwig's suggestion that possibly the Madreporarian corals are a heterogeneous assortment of hexactinian polyps, which have independently acquired a skeleton. Dr. Wilson drops the hint that the study of the mesenterial filaments affords a negative argument. "Porous and aporous corals alike have simple filaments, but actinian have trifid filaments."

Entozoa of Marine Fishes.—Professor Edwin Linton has published a first paper on these forms, which, though included in the Fish Commission Report for 1886, did not appear until 1889. Professor Linton has spent several summers at Wood's Holl collecting the internal parasites of fishes. In the present paper he confines himself to the Cestods and Acanthocephala. Seventeen species in all are enumerated, of which ten are regarded as new, while three new genera are made in the paper. The general distribution of these parasites is summarized thus by Mr. Linton: Cestoid entozoa in the adult or strobile condition were found in great numbers in the alimentary tracts of all the Selachians examined. Encysted forms of the Cestoidea are for the most part confined to the Teleostei, and are found in greatest abundance in the sub-mucous coat of the stomach and intestine, although not infrequently met with in the peritoneum, liver, spleen, ovaries, etc.

A Two-Tailed Earth-Worm.—Some time ago one of my students brought in a specimen of a two-tailed earth-worm. While the literature of the subject is not at present accessible to me, I am under the impression that no such abnormal form has been reported from the United States, although several have been found in other parts of the world. When the animal was alive it seemed really two-tailed, the parts appearing of equal importance, but in the alcoholic specimen one division appears like a lateral branch, and is quite markedly constricted where it joins the body of the worm. Branches of the intestine and ventral nerve cord pass to both divisions, and there are two functional ani. The alcoholic specimen is 34 mm. long, the "tails" being about 12 mm. long.—C. Dwight Marsh, *Ripon College*.

Compound Eyes of Arthropods.—Mr. S. Watase has presented (Studies, Biol. Lab., Johns Hopkins, IV., No. 6) an extremely ingenious view of the morphology of the compound arthropod eye. The compound eye is formed by the vegetative repetition of the visual unit or *ommatidium*. In Serolis each ommatidium constists of two *corneagen* cells, which secrete on their outer (free) surface the chitinous cornea. Beneath these come two other cells (*vitrellæ=retinophoræ*), which secrete on the surfaces toward the axis of the ommatidium the chitinous *crystalline* cone, which, according to Watase, is purely dioptric, and has no connection with the optic nerve fibres. Beneath the vitrellæ are the *retinulæ*, cells which have their deeper ends in communication with the optic nerve, while their surfaces toward the axis of the ommatidium secrete a chitinous rod or *rhabdomere*. This structure is therefore to be regarded as a pit of ectoderm the cells of which, like

all ectoderm cells, are capable of secreting chitin, and the pit is filled by this secretion. To this scheme can all compound eyes of Crustacea be reduced; with, of course, the addition of pigment cells, etc. In the compound eye of Limulus we have a very ancestral condition. The ectodermal pit remains open, and there is no distinction between cornea and crystalline cone, while the rhabdomeres exist as extremely delicate chitinous rods. "According to this view the compound eyes of Arthropods, either in the sessile or in the stalked forms, are nothing more than a collection of ectodermic pits, whose outer open ends face toward the sources of light, and whose inner ends are connected with the central nervous system by the optic nerve fibres. The cells forming the walls of the pit arrange themselves into three strata, in most cases accompanied by three regional functional differentiations. Grenacher's classification of the compound eyes of insects into 'acone,' 'pseudocone,' and 'eucone' types refers to the condition of the cells and their products in the middle stratum—the vitrellæ. Morphologically, then, the compound eye of an Arthropod is strictly single-layered, although, as is evident, the present conception is entirely different from the monostichous theory maintained by some recent writers." Mr. Watase further describes the development of the compound eye of Limulus, and inserts as an appendix some observations on the eyes of starfishes, which, as he shows, can be reduced to the type described among the Arthropods—a pit of ectoderm, the cells of which secrete a cuticle upon their free ends.

Tortoises Sold in the Markets of Philadelphia.—The taste for "stewed terrapin" and "snapper soup" has become so general in Philadelphia, that the United States are now ransacked for the means of supplying it. Within a few years the species sold were the "terrapin," *Malacoclemmys palustris;* the "red-belly," *Chelopus insculptus;* the "slider," *Chrysemys rugosa;* and the "snapper," *Chelydra serpentina.* Now large invoices of turtles are sent from Mobile, New Orleans, and St. Louis, which include the following species: *Chrysemys bellii, C. elegans, C. concinna,* and *C. troostii; Malacoclemmys geographica,* and *M. leseurii;* total, exclusive of sea turtles, ten species. All are abundant in the market except the *C. bellii.*—E. D. Cope.

Zoological News.—Vermes.—Beddard (Proc. Zoöl. Socy., London, 1889) catalogues the Oligochætes of New Zealand, enumerating fourteen species. His conclusions of the relationships of the fauna

to that of Australia are: The Olighcoætous fauna of New Zealand differs markedly from that of Australia, in which the characteristsc genera, represented by numerous species, are Megascolides, Perichæta, and Cryptodrilus. The characteristic New Zealand form is evidently Acanthodrilus, while Perichæta is represented by but few species.

Arthropods.—Benham thinks that the structures found in a New Zealand earth-worm (*Acanthodrilus multiparvus*) throw light upon the possible origin of the Malpighian tubules in the Arthropoda. In this worm minute cæcal diverticula arise from the (? hind) gut, but a little farther forward similar tubules become continuous with undoubted nephridia. These are certainly comparable to the anal nephridia of the Gephyrea, and in order to convert them into Malpighian tubules is to limit their number and arrange them in regular order, their inner ends being closed.

Fishes.—Jordan & Fisher describe as new (Proc. Acad. Nat. Sci. Philadelphia, 1889) *Orthopristis lethopristis* from the Galapagos Islands.

Meek and Bollman describe (*l. c.*) two specimens of *Elegatis bipinnulatus* Bennett, taken off Long Island, N. Y., the first occurrence of the species in the waters of the United States.

Willard Morrison (*l. c.*) reviews the American species of Priacanthidæ. He regards the family as an offshoot of the Serranidæ, and recognizes two genera—*Priacanthus* with the species *catafula, crentatus* and *bonariensis,* and *Pseudopriacanthus* with a single species, *altus.*

Ph. Kirsch and Morton Fordice (*l. c.*) review the American Sturgeons. The species recognized are *Scaphirhynchus platyrhynchus* and *Acipenser sturio, medirostris, rubicundus, brevirostrum* and *transmontanus.*

Ph. Kirsch (*l. c.*) recognizes the following species of Uranoscopidæ in Europe and America: *Kathetostoma averruncus, Uranoscopus scaber, Astroscopus anoplos, Upsilonophorus Y-græcum, U. guttatus.*

Birds.—Beddard (*Ibis,* Jan., 1890) describes the alimentary canal of the Martineta Tinamou (*Calodromas elegans.*) The cæca differ from those of all other Crypturi, being furnished with numerous small diverticula, giving the inner surface an appearance not unlike the ventriculum of a ruminant's stomach.

Witmer Stone shows (Proc. Acad. Nat. Sci. Philadelphia, 1889,) that Sharpe has mistaken Verreaux's *Pratincola salax*, and that it is identical with *P. sybilla* Linne. *P. axillaris* Shelly may be a variety of the same.

Mammals.—Ryder (Proc. Am. Philos. Soc., XXVI., 1889) seeks the phylogeny of the mammalian sweat gland in the epidermal glands of the Batrachia. C. Hart Merriam (*North American Fauna*, No. 1; pubished by the U. S. Department of Agriculture) presents a revision of the North American pocket mice. With abundant material, he has recognized eighteen species, but has united the two genera Perognathus and Cricetodipus. Many changes in synonymy are noticeable. In a second paper (l. c., No. 2) the same author describes fourteen new species of mammals from North America, arranged in the genera Onychomys, Arctomys, Lagomys, Spermophilus, Tamias, Nyctionomus, and Phenacomys (nov.).

Beddard (Proc. Zoöl. Soc., London, 1889) describes the visceral anatomy and brains of the American tapir. He concludes that the American species is distinguished from the Indian by the absence of well marked valvulæ conniventes, the presence of a moderator band in the heart, the shape of the glans penis, and a more elongate cæcum sacculated by four bands. The cerebral convolutions are simpler in Tapirus than in other living Perissodactyles.

Dr. R. W. Shufeldt describes (Proc. Acad. Nat. Sci., Philadelphia, 1889) the skull in an embryonic specimen of the California wood-rat, *Neotoma fuscipes*.

Dr. Frank C. Baker describes (l. c.) the habits of the recently discovered round-tailed muskrat, *Neofiber alleni* True.

EMBRYOLOGY.

The Placentation of the Hedge-hog (*Erinaceus europaeus*), **and the Phylogeny of the Placenta.**[1]—Prof. A. A. W. Hubrecht has placed embryological students under great obligations to him for this admirable work upon the development of the hedge-hog. There is room, however, for very wide difference of opinion as to the significance of the facts recorded. While no one will probably be disposed

[1] *Quar. Jour. Mic. Sci.*, XXX., Pt. 3, 1889, pp. 283-404. Plates XV.-XXVII.

to question the primitive position in many features, especially so far as adult characters are concerned, of the hedge-hog and its insectivorous allies, the assumption that its placentation is primitive is a very different matter. While no one can help but admire the wonderful fidelity and care with which the facts of placental development are recorded, since the plates for histological details are simply unrivalled, the conclusion that the placentation of the hedge-hog is primitive is far from warranted.

So far from Prof. Hubrecht's assumption as to the primitive nature of this type's placenta being borne out by his facts, it is distinctly and emphatically negatived by them. In the first place, a "reflexa" such as is described by him is found in comparatively few forms. Moreover, such a development of the uterine mucosa is distinct evidence in favor of the conclusion that the placenta in forms having such a "reflexa" is specialized. In some rodents, man, possibly Tamandua, also Erinaceus, Talpidæ, Rhynchocyon, in all of which it is pretty certain that the whole complex series of primary differentiations of the blastocyst or blastodermic vesicle are completed without the accompaniment of an excessively rapid growth in its size, such as occurs in the rabbit and opossum, where also there is either no reflexa formed, or traces only of such an organ are developed later. In the first-named forms there has occurred an adaptive abbreviation of the early processes of development, which have not supervened in the last two, or in the rabbit and opossum.

The peculiar mode of development of the hypoblast in the hedgehog is again specialized and widely different from what it is in most rodents.

In the same way the site of the placenta and the germinal area are different from those of other types, and therefore specialized. In the first place, the embryo itself is formed at a point in the blastodermic vesicle which is exactly opposite its homologue in the rabbit, mouse, and rat, and probably even man, Bradypus, and Tamandua, as well as many carnivora. In these last-named it is formed in a dorsal position in the uterine lumen or just beneath the insertion of the mesometrium. In Erinaceus the embryo is formed at a point on the surface of the blastocyst diametrically opposite to the point of insertion of the mesometrium. The embryo in the first-named series therefore has its dorsal aspect coincident at first with that of the parent ; in the hedgehog that aspect coincides with the ventral aspect of the parent. The site of the attachment of the placenta is similarly reversed. In the majority of forms the position of the placenta is immediately beneath

the insertion of the mesometrium. In Erinaceus the placenta fœtalis is affixed to the side of the lumen of the uterus diametrically opposite to the insertion of the mesometrium. The conclusion is therefore forced upon us that *there is no exact homology between the maternal portion of the placenta in the hedge-hog and that of the same part in the large majority of other mammalian types.* The name "trophoblast" which Hubrecht proposes for the "outer layer" of the blastocyst is exceedingly apt and convenient, while his elaborate studies as to the role it plays in the formation of the placenta, as well as its growth and fate, constitute a most valuable contribution to the embryology of the higher vertebrates. Nevertheless, one cannot help regretting that the obvious and clear homology of this layer with the serous envelope, subzonal membrane,—*Deckschicht* as this layer has been variously called,—has not been more strongly emphasized. Of such a homology there cannot be the slightest doubt; the only difficulty in making it out is due to the excessive concentration or abbreviation of the early stages of development already referred to. The modification of their early stages and their abbreviation in mammalia are also clearly adaptive and directly so under the influence of trophic stimuli, which differ very widely in character in the different mammalian orders. These differences are apparently due to the effects of what may, for want of a better phrase, be called the reciprocal trophic stimuli exerted reciprocally upon each other by the blastocyst and uterine walls in the different types during the initial stages of development. The variations in the differentiation and arrangement of the mucosa and its vessels in the different forms must have had something to do with the genesis of such different methods of differentiation of the primary stages of mammalian development. The expectation of ever unravelling thef causes of such differences through a study of the early development of the fœtus alone will be fruitless. The processes are in the clearest possible manner directly adaptive in certain very definite ways, which purely morphological study is utterly and forever incapable of explaining, and is no less irrational and absurd than to attribute such modification to the "action" of natural selection.—JOHN A. RYDER.

PHYSIOLOGY.

Electrical Phenomena in Human Skin.—Tarchanoff[1] makes some interesting discoveries regarding the electrical phenomena in the human skin, accompanying the stimulation of sense-organs and different forms of psychic activity. He connects different parts of the skin with the galvanometer, *e. g.*, palm and back of hand or of foot, palm of hand and outer surface of forearm, latter and axilla, etc. Slight tickling of the body surface produces a considerable movement of the galvanometer mirror, following a latent period of from one to three seconds, and continuing sometimes for several minutes after the stimulus has ceased. Other stimuli cause similar electric currents, such as heat, cold, pain, electric shocks, sounds, such as speaking and hand-clapping, sniffing of ammonia and acetic acid vapor, sugar and other sapid substances placed upon the tongue, light thrown into the eyes as when the eyelids are merely opened to ordinary light. The author goes further and finds that merely imagining these sensations, without any stimulus of the sense-organs whatever, is sufficient to produce analogous galvanic disturbances; for example, if the individual fancies himself to be enduring intense heat, a strong cutaneous current appears. Mental processes, such as the multiplication or division of numbers, are accompanied by currents varying in intensity according to the complexity of the process; thus, arithmetical problems, the answers to which may be taken direct from the multiplication table, call forth almost no electric change. Expectation of stimuli or of questions to be answered causes irregular movements of the galvanometer mirror. Voluntary movements cause changes of an intensity proportional to the amount of movement. Fatigued individuals show little or no galvanic effects.

In all of these cases the portion of the skin richer in sweat glands becomes negative to the other portion. The author hence regards the current as a secretion current. The results go to confirm the idea that nearly every kind of nerve activity, from the simplest to the most complex, is accompanied in man by increased activity of the sweat glands, and to strengthen Hermann's view that the current exhibited in the contracted human hand is a secretion current, not a negative variation of a preexisting muscle current. In explanation of the fact of increased sweat secretion accompanying nerve activity, the author casually suggests that, inasmuch as the latter causes an increase of

[1] Pfüger's *Archiv*, Vol. XLVI., p. 46.

temperature and an accumulation of waste products, the perspiratory activity is useful as a regulator by cooling the body and eliminating the wastes.

Electrical Phenomena in Beating Heart.—Dr. Waller has investigated[2] more fully the electromotive changes in the contracting mammalian heart. The exposed and spontaneously beating heart of the cat was studied *in situ* by means of the capillary electronometer. The electrical variation of the ventricle resulting from a single beat was found to be diphasic, indicating negativity of apex followed by negativity of base. This confirms the author's former discovery by mechanical methods that the contraction of the apex precedes that of the base, which is the reverse of what takes place in the frog. Some preliminary experiments were tried on animals to determine whether the electrical variations accompanying the heart beat could be detected on the surface of the body. These were successful, and led to a study of the electrical variations of the heart in man.

It was found that leading off from points of the surface of the body remote from the heart in the intact animal or in man gave the same diphasic variation accompanying the ventricular contraction, the auricular contraction giving no electrical indication. The most favorable positions for the electrodes are on either side of a line running at right angles to the long axis of the heart. Such a "line of zero potential" in the normal human being, with heart tilted to the left, extends from the left shoulder to the right side; in the quadruped, with heart toward neither side, it is transverse to the body axis. Leading off from any point anterior to this line is equivalent to leading off from the base of the ventricles; leading off from a point posterior to this line is equivalent to leading off from the apex. Thus, in man electrodes placed on the right hand, and either the right or the left foot or left hand, gave a good variation; not so the left hand, and either the right or left foot. Favorable combinations are the mouth and the left hand, the right foot, or the left foot; an unfavorable one, the mouth and the right hand. In the cat a favorable combination is either anterior extremity with either posterior extremity, but not the two anterior extremities with each other. The electrical variation precedes the mechanical movement of the heart, and is always diphasic, indicating, as in the exposed heart, negativity of apex followed by negativity of base. It would seem, then, that in the human heart, and mammalian hearts generally, unlike the amphibian, the contrac-

[2] Philosophical Transactions, Vol. 180 (1889), B., p. 169. Cf. also Vol. 178 (1887), B., p. 215.

tion by which the ventricle empties itself begins at the apex and closes at the base.

Relations of Nerve Fibres and Ganglion Cells.—Langley and Dickinson[3] have discovered a method that promises to yield important results in the investigation of this question. In studying the effect of nicotin on the cervical sympathetic nerve they learned that after a dose of the drug stimulation of the sympathetic fibres below the superior cervical ganglion does not produce dilation of the pupil or constriction of the vessels of the ear, while stimulation above the ganglion produces both changes as usual. By applying nicotin to nerve and ganglion at different times they conclude that the poison paralyzes the ganglion nerve cells. This suggests a method of isolating the nerve fibres joining the ganglion cells from those passing through without such junction. Regarding the superior cervical ganglion, the authors conclude that the dilator fibres for the pupil, the vaso-constrictor fibres for the ear (probably also for the head generally), and the secretory fibres for the glands end in the ganglion cells. Regarding the relations of the vagus and splanchnic nerves to the ganglia of the solar plexus, it would appear that the stomachic inhibitory fibres of the splanchnic end in the cells of the cœliac ganglion, the intestinal inhibitory fibres of the splanchnic in the cells of the superior mesenteric ganglion, while the motor fibres of the vagus do not join the cells of the solar plexus; vaso-constrictor and vaso-dilator fibres of the splanchnic end in cells of the solar and renal plexuses. Other peripheral ganglia have been studied with results. The nicotin appears to affect the nerve fibres very slightly, but this effect is not to be compared in intensity with that on the nerve cells. Numerous interesting questions are suggested by the research, viz., among others, whether by nicotin centers may be isolated, and tracks followed in the brain and spinal cord.

Physiological Prize.—A member of the Physiological Society has offered two hundred and fifty dollars for the best research or researches bearing on the subject stated below, viz: "The regeneration of severed spinal nerves in mammals, including man, with special reference (1) to the reunion and return of function in such severed nerves, without degeneration of the distal portion; (2) to the possibility of union, with return of function, between the central portion of any one spinal nerve and the distal portion of any other (*e. g.*, the central portion of the ulnar with the distal portion of the median)."

[3] Proceedings of Royal Society, No. 284, p. 423.

Conclusions are to be supported, so far as possible, by histological as well as physiological evidence. The competition is limited to residents of North America, and the prize will be awarded for original work done between January 1, 1890, and October 1, 1891. Communications concerning the prize should be addressed to Professor H. Newell Martin, Johns Hopkins University, Baltimore, Md.

PSYCHOLOGY.

The Effect of Whistling on Seals.—While reading of "Instances of the Effects of Musical Sounds on Animals," by Mr. Stearns, in which I have been much interested, it recalled to my mind apparently similar effects produced upon seals, which I often noticed during a prolonged stay in Hudson's Strait. Here the Eskimo might often be seen lying at full length at the edge of an ice-floe, and, although no seals could be seen, they persistently whistled in a low note similar to that often used in calling tame pigeons, or, if words can express my meaning, like a plaintive phe-ew, few-few, the first note being prolonged at least three seconds. If there were any seals within hearing distance they were invariably attracted to the spot, and it was amusing to see them lifting themselves as high as possible out of the water, and slowly shaking their heads, as though highly delighted with the music.

Here they would remain for some time, until one perhaps more venturesome than the rest, would come within striking distance of the Eskimo, who, starting to his feet with gun or harpoon, would often change the seal's tune of joy to one of sorrow, the others making off as fast as possible.

The whistling had to be continuous, and was more effective if performed by another Eskimo a short distance back from the one lying motionless at the edge af the ice.

I may add that the experiment was often tried by myself with the same result.—F. F. Payne, *Toronto, March 26, 1890.*

ARCHEOLOGY AND ETHNOLOGY.

Fort Ancient, Ohio.—(By WARREN K. MOOREHEAD. Cincinnati, O., Robert Clarke & Co.)—This volume of Mr. Moorehead's is a valuable contribution to antiquarian literature. It is confined to the description of this fortification alone.

Fort Ancient is located in central Warren County, Ohio, some forty-two miles northeast of Cincinnati, on the P. C. and St. L. R. R. It lies upon a plateau 269 feet above the Little Miami River, which it overlooks and which flows at its base. The walls forming the enclosure follow the brink of deep ravines. The embankments are mostly of earth, although in places there are great quantities of stone. These rocks comprise flat slabs of limestone and some few pieces of sandstone, A deep ravine, having a slope of thirty-five to thirty-eight degrees. follows the earthwork for nearly a mile and a half on the western and southern sides. The embankment is built directly upon the edge of the ravine, so that the earth used in its construction has rolled down upon the outside. Thus the earth artificially placed can be distinctly traced forty feet from the summit of the earthwork. At the same place the inside measurement of the wall is twelve to fifteen feet.

The accompanying map of the structure will indicate the peculiar features.

In its topographical work, its illustrations, its intelligent description of the excavations, the volume is deserving of large praise.

Mr. Moorehead, with his party, spent the entire summer of 1889 at Fort Ancient, preparing material for the book.

We may differ from Mr. Moorehead in some of his conclusions, yet we cannot but admire the thoroughness with which the structure has been examined, and the completeness of the survey. In this regard it is worthy the imitation of more pretentious parties.

The work is more laudable because Mr. Moorehead was not assisted by any institution or person, but bore the expense of the investigations himself.

The first few chapters of the book deal with the outline of the structure, measurements, etc. Those following describe the stone graves and mounds explored, while the remaining chapters give quotations from some twenty prominent antiquarians upon Fort Ancient, and express the author's conclusions.

The distances of various points of interest have been ascertained with care; the length of the embankments in the Old and New Forts is 18,712 feet. The length of the crescent in the New Fort is 269 feet; length of the parallel walls, 2760 feet; the distance in a straight line between the extreme part of the New Fort to that of the Old is 4993 feet. The average height of embankment is twelve and one half feet. In the highest places (where the walls cross the eastern side of the plateau) it reaches an altitude of twenty-two feet, while in one locality, where scarcely any protection on account of precipitous ravines is necessary, it is but three and one-half feet high.

Two classes of burials were discovered; the one being made in stone graves, while the other was a simple interment under a small heap of stones. The former order of burial resembles the stone graves of Tennessee. A village site and cemetery similar to that of Madisonville, Ohio, was revealed by excavations in the valley adjacent to the Miami River. Out of this valley were taken a quantity of refuse such as would accumulate from an aboriginal village. The deposits were found at three levels, the deepest being five feet below the surface. As the pottery of the lower deposit was different from that discovered above, Mr. Moorehead is of the opinion that various tribes occupied this region.

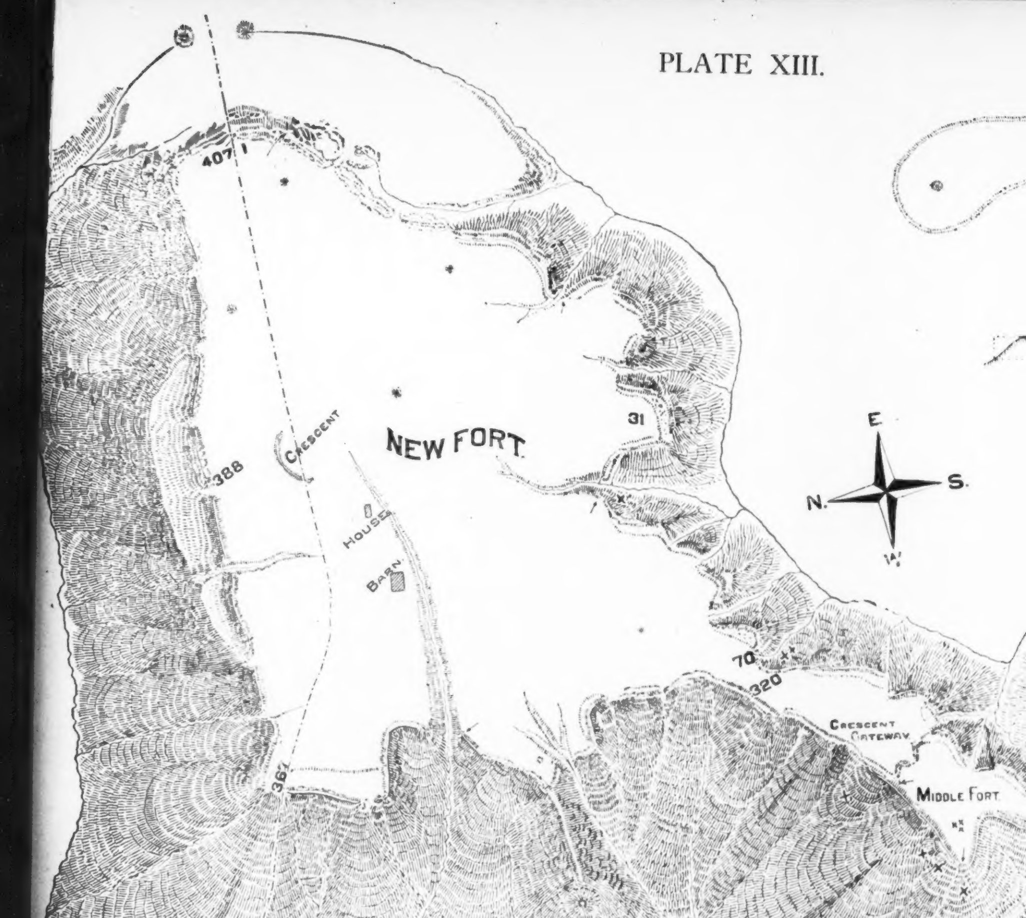
The general conclusions drawn are interesting. He is led to conclude from his examination of the place that the fortification was erected by one people as a defence against a hostile tribe or nation. He thinks that the neighboring Indians living within a radius of one hundred miles were allied and held in common this structure, that a number were constantly detailed to keep it in repair, and that in case of an invasion they congregated here for safety.

Mr. Moorehead gives the following definition of Fort Ancient: "Fort Ancient is a defensive earthwork, used at times as a refuge by some large tribe of Indians; and at intervals there was a large village situated within the walls."

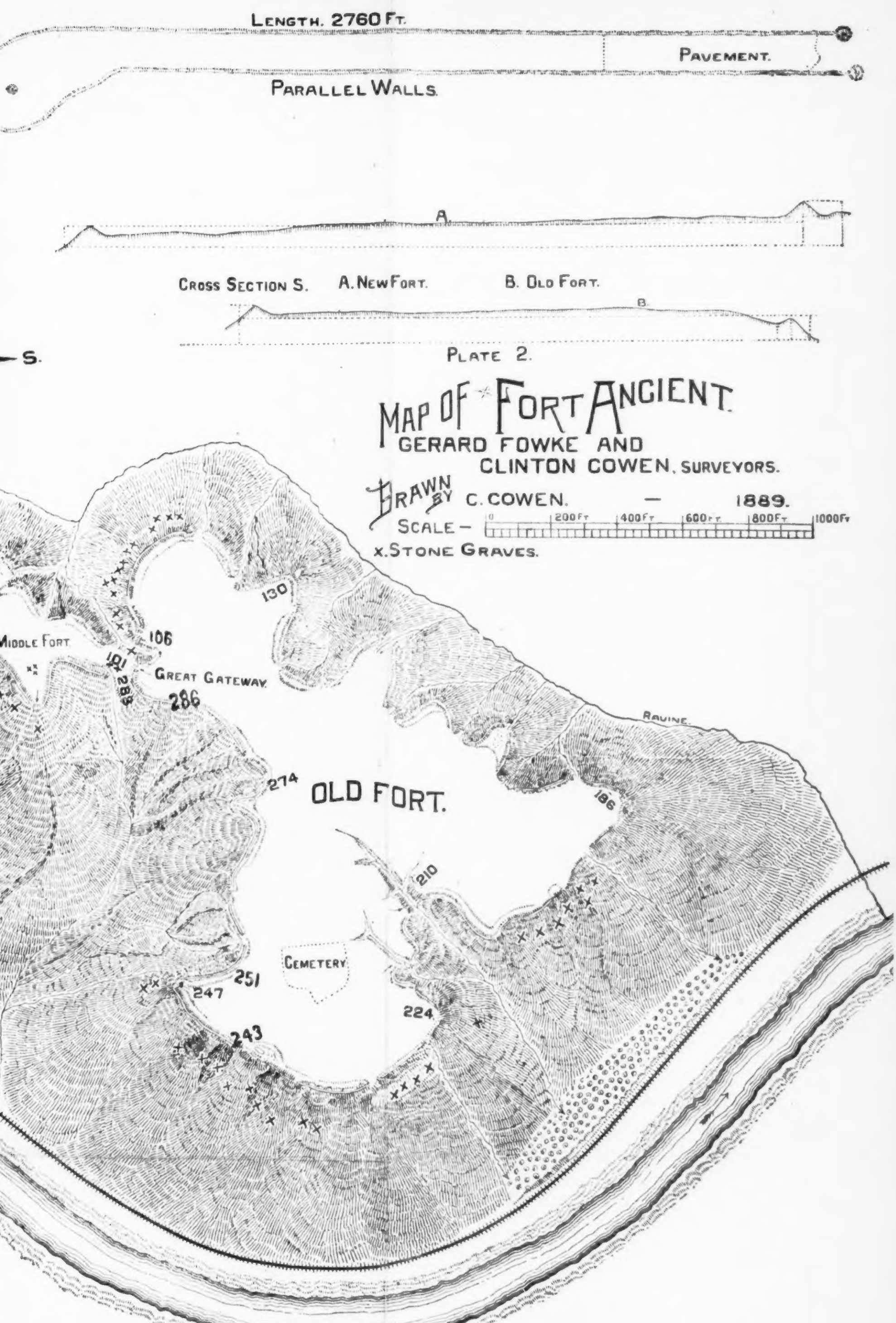
In the excavations upwards of two hundred skeletons were exhumed, an aboriginal stone pavement 130 by 500 feet discovered, etc. Altogether the work is commendable, and we would feel inclined to criticise but slightly. A ground plan of the fort is given, which is reproduced in the accompanying Plate XIII.—THOMAS WILSON, Smithsonian Institution.

March 15th, 1890.

PLATE XIII.



407
NEW FORT.
CRESCENT
388
HOUSE
BARN
31
E.
N.
S.
W.
70
320
361
CRESCENT GATEWAY
MIDDLE FORT.
RAVINE.
L. AND C. TURNPIKE.
P.C. & ST. L. RAILROAD.
LITTLE MIAMI RIVER.
HOTEL
STATION
VILLAGE SITE.


LENGTH. 2760 FT.
PAVEMENT.
PARALLEL WALLS.
A.
CROSS SECTION S.
A. NEW FORT.
B. OLD FORT.
B.
S.
PLATE 2.
MAP OF FORT ANCIENT.
GERARD FOWKE AND
CLINTON COWEN, SURVEYORS.
DRAWN BY C. COWEN. — 1889.
SCALE — 0 200 FT 400 FT 600 FT 800 FT 1000 FT
x. STONE GRAVES.
130
MIDDLE FORT
106
101
288
GREAT GATEWAY.
286
RAVINE.
274
OLD FORT.
186
210
CEMETERY
251
247
224
243

SCIENTIFIC NEWS.

5. Notes on the Paleontological Laboratory of the United States Geological Survey under Professor Marsh.

If there is any truth left under the sun then judgment must fall on the scientist who walks the halls of the Yale Museum armed with a wet sponge. Why a wet sponge? you say. Perhaps it was to wipe the dust from some noble fossil? Far from it! but rather to wash the purity of a truth out of the blackness of a falsehood. A kind of organized touchstone that distinguishes the little gold from the bulk of dross, which when deftly swept across the surface of a restored fossil, discloses the real and the unreal. For plaster of paris is porous, and absorbs more readily than the denser fossil any moisture from the sponge. So the blackened sepulchres yield up their grewsome skeletons. Veritable sepulchres they necessarily seem to those who have seen these fossils "black-washed" from centrum to spine, from shaft to extremities, reducing the whole to a uniformity of color that wiped out absolutely every vestige of the truthful white plaster, leaving mankind in doubt as to what is real, what conjectural. This is illegitimate restoration in the eyes of the whole world, and these old bones, restored to deceive rather than to instruct, must sooner or later stand as monuments of reproach to the man who has so far deceived the world and himself that he can only study them with a wet sponge.

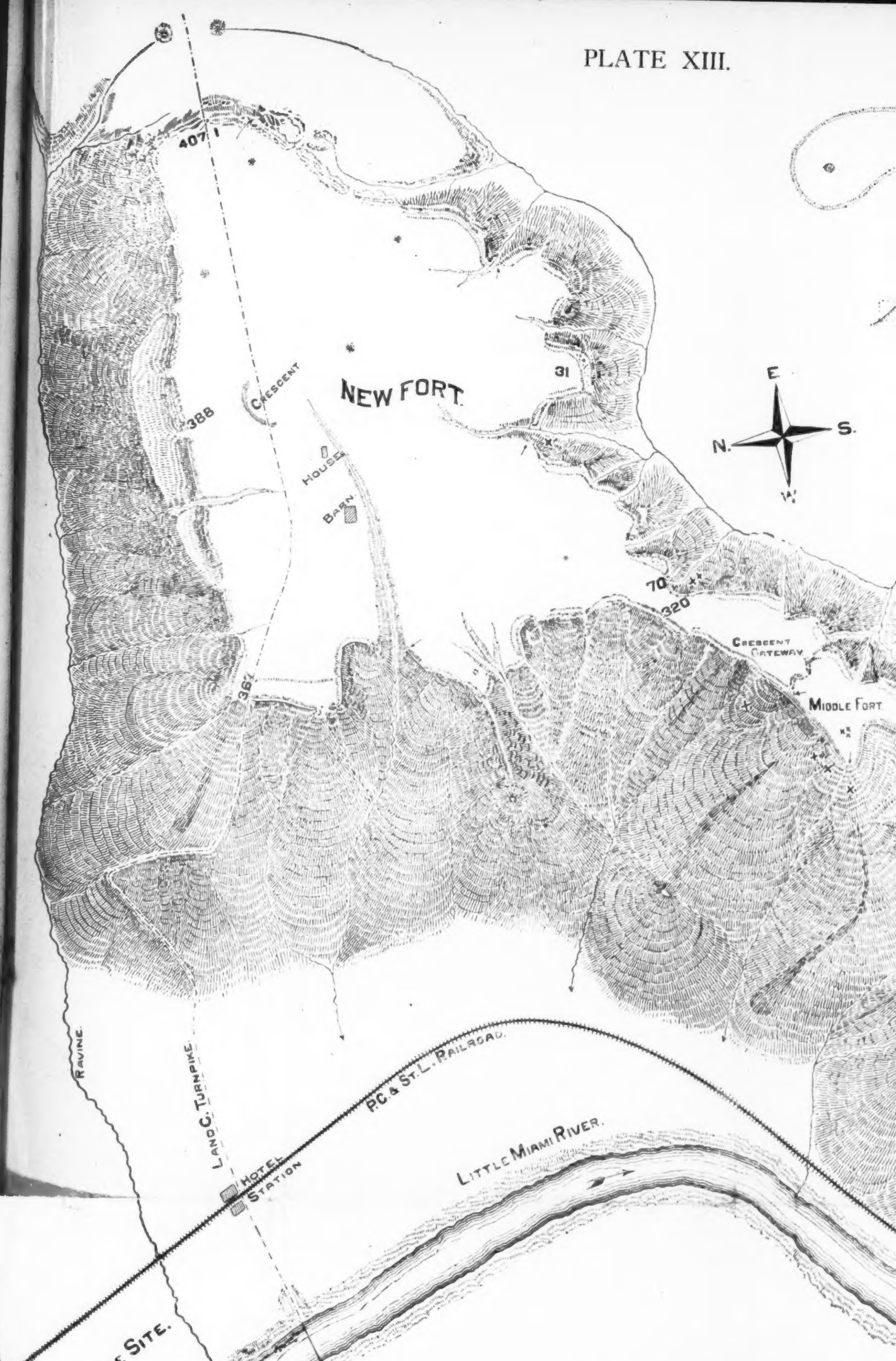
To those scientists in foreign lands, especially Germany, who have marveled at the exceptional beauty and perfect preservation of Prof. Marsh's specimens, let it be said that although you cannot apply the sponge test to his faultless, fractureless plates, you can to the specimens from which they were drawn. But to see any man year after year calling for a wet sponge to assist him in determining whether a suture or a fracture were real or imitations wrought cunningly in the plaster by skilled labor, is to believe him worthy of the unqualified distrust of science, wherever that word is spoken. One feels this the more keenly when he knows that all his assistants to a man have repeatedly advised with him, and cried out against this abuse, warning him of the criticism inevitably resulting from such a stubbornly unscientific and misleading course. His assistants are asked, not how nearly they can approximate the truth, but instead, "How closely can you imitate the color and texture in that missing part?" which being translated is, How cunningly can you deceive? "That part looks too smooth; can't

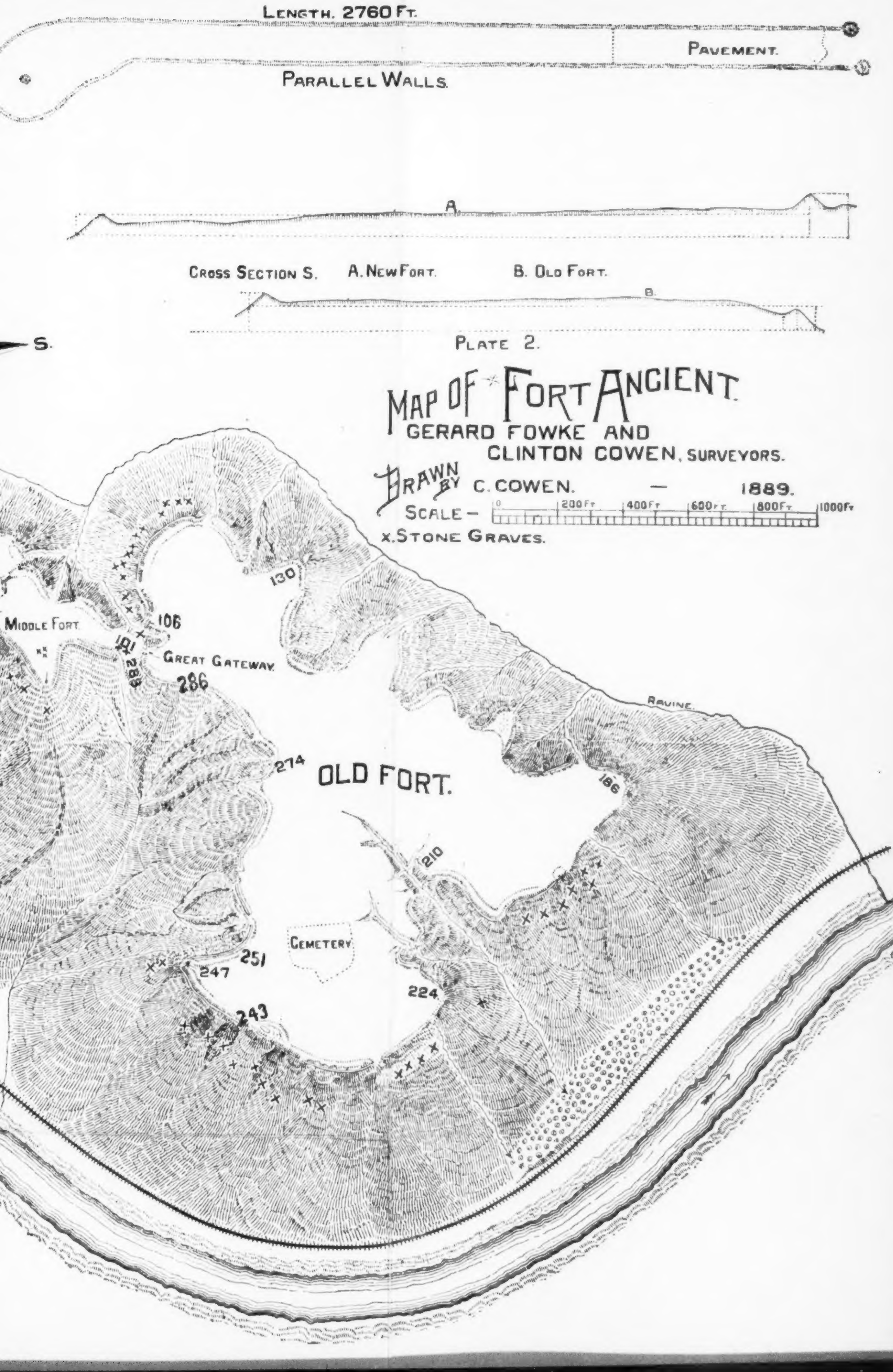
you work in a crack or two to give it a natural look?" "Just run a suture along here, and scrape that process there to make it look like the roughnesses for cartilaginous or ligamentous attachment."

At first the plaster worked badly, for many of the bones were black, and to get that color in white plaster it was necessary to add such quantities of lamp-black (with alcohol to make it mix with the water) that the restored parts were soft and crumbled away. To overcome this, glue water was added, which gave hardness, but like all glue was treacherous, drying, cracking, scaling off and pulling away from its moorings, thus exposing too clearly just where the fossil left off and the fraud began. It was not until he had learned how to combine plaster, bone-black, and gum acacia, that a mixture capable of unlimited possibilities was adopted. Were it possible, I would say, Verify these words,—but you can't. Stand straight before these restored specimens, in the full and truthful light of day, and you can't distinguish between the rusty, frost-cracked, weather-beaten, moss and lichen effects, craftily wrought in the plaster, and the conditions wrought by time on the specimens themselves. But if critical study can reveal—without the helpful sponge—the restored parts in some bones, it can't in others, some of which were prepared by myself, at his direction, in my earlier days on the Survey, and are so craftly modeled and colored that I cannot myself distinguish at arm's length the real fossil from the plaster. Of course the deceits and falsities of the specimens thus tampered with were naturally enough transmitted to the drawings, and the old deceits and falsehoods were enacted anew—compromising that pre-eminently reliable Journal. Yes, still a third time, in the costly plates of the government monographs, thence to be copied and repeated in other ways, how often who will say?—for a falsehood is proliferous and self-propagating. If the deceptions thus practised were confined to the specimens themselves, and not transmitted to paper and then distributed throughout the world, it would not seem so serious an evil. As it is, the Geological Survey must necessarily suffer reproach either now or in the future.

Geologists abroad who cannot acquaint themselves personally with the facts, may find in the above an explanation of the striking absence in Professor Marsh's plates of those conventional bars, light shading, and simple outlines which fair-minded scientists universally use to honestly indicate missing parts. In very marked contrast to his course is that of foreign geologists, and our own paleontologists. Their plates show things as they actually are, and are not daubed with plaster to enlarge, distort, or conceal anything at the caprice of the

PLATE XIII.


407
NEW FORT.
CRESCENT
388
HOUSE
BARN
31
E.
N.
S.
W.
70
320
CRESCENT GATEWAY
MIDDLE FORT
361
RAVINE
L. AND C. TURNPIKE
P.C. & ST. L. RAILROAD.
LITTLE MIAMI RIVER.
HOTEL
STATION
VILLAGE SITE.



LENGTH. 2760 FT.
PAVEMENT.
PARALLEL WALLS.
A.
CROSS SECTION S. A. NEW FORT. B. OLD FORT.
B.
S.
PLATE 2.
MAP OF FORT ANCIENT.
GERARD FOWKE AND
CLINTON COWEN, SURVEYORS.
DRAWN BY C. COWEN. — 1889.
SCALE — 0 200 FT 400 FT 600 FT. 800 FT. 1000 FT
X. STONE GRAVES.
130
106
MIDDLE FORT.
GREAT GATEWAY.
286
RAVINE.
274
OLD FORT.
186
210
CEMETERY
251
247
224
243

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Papers Read Before the Anthropological Society of Washington During the Year 1889.—"The Shinto Faith," by Mr. Romyn Hitchcock. "Anthropology at the Paris Exposition," by Profs. O. T. Mason and Thomas Wilson. "Some Omaha Religious Practices," by Rev. J. Owen Dorsey. "Ancient Chipped-stone Workshops on Piney Branch, D. C." by Mr. W. H. Holmes. "The Cherokee Ball Play," by Mr. James Mooney. "Remarks on American Archæology," by Major J. W. Powell. "Attempts to Promote Prosperity by Limiting Production," by Mr. Wm. A. Croffut. "Human Footprints in Dakota" (Illustrated), by Mr. Henry I. Reynolds. "Vesper Hours of the Stone Age," by Capt. John G. Bourke, U.S.A. "The Archæology of North America," by Major J. W. Powell. "Ojibwa Ball Play," by Dr. W. J. Hoffman. "Prometheus (The Fire-maker), by Mr. Walter Hough. "Gentes of the Navajos," by Dr. Washington Matthews, U.S.A. "Gentes of the Apaches," by Capt. John G. Bourke, U.S.A. "Olecranon Foramen," by Dr. D. S. Lamb. "Tibet," by Mr. W. W. Rockhill. "The Origin of Llao Nous, a Legend of the Shasta," by Mr. Mark B. Kerr. "Christophe Plantin, the Antwerp Publisher of the XVIth Century," by Mr. G. R. Stetson. "The Societe d'Anthropologie of Paris," by Mr. Thomas Wilson. "The Omahas as Mound Builders," by Mr. H. I. Reynolds.

Biological Society of Washington.—March 22d.—The following communications were read: "Change in the Color of Human Hair, Change in the Color of Plumage in Birds, and in the Fur of Mammals," with specimens, by Dr. D. W. Prentiss. "The Color of Fishes," by Mr. G. Brown Goode. "The Colors of Insects," by Prof. C. V. Riley.—FREDERIC A. LUCAS, *Secretary.*

Natural Science Association of Staten Island.—March 13, 1890.—Mr. L. P. Gratacap exhibited specimens of quartz geodes and limonite concretions from the iron mines near Four Corners, loaned for the occasion by the superintendent of the mines, Mr. Amos Smith. Following is an abstract of Mr. Gratacap's remarks:

The specimens form but a small proportion of those which Mr. Smith has collected, and although they embrace but two, or at most three, mineralogical species, they are interesting from their real beauty, and for the speculations they suggest as to their origin. The species are quartz, limonite, and Göthite. The latter occurs as a delicate closely appressed velvety surface, bronzed yellow in color, and

consisting of a film of minute needles. It may be referred to the variety of Göthite known as "sammet blende," and is strikingly beautiful when its color and texture appears in a direct light. The limonite is shown in siliceous concretions, sometimes in concentric shells, and in other instances enclosing ferruginous pebbles, between which an infiltrating seam of iron cement has thrown interior partitions. The quartz groups are large and handsome, and occur as geodes or small rounded mounds of slightly divergent, faintly amethystine crystals. They are characteristically alike in having the individuals composed of groups of interfering pyramids, amidst which the central crystal, most fully developed, rises, and at a distance seems to blend the jutting faces of the subordinate rhombohedrons with its own, and form a single stout termination. This peculiarity gives a slightly drusy appearance to the entire surface. The elements of as many as twenty-four pyramids are seen in some of the groups. These quartz groups have all doubtless formed the central crystallizations of geode-like siliceous balls or conduits. They have been found by Mr. Smith at the lower levels of the surface diggings, near the underlying serpentine ledges. The ores in which they occur are highly siliceous limonites, which were deposited, in all probability, by the oxidation of iron salts carried upward by thermal waters flowing through the crevices of the serpentine mass, and fed to some extent by surface waters carrying dissolved iron oxides, a process made familiar by the papers of Drs. Hunt and Julien. This view is supported also by Dr. Britton (Geol. Richmond Co. Ann., N. Y. Acad. Sci., Vol. II., p. 177).

Now the experiments of Schafhäutl, Senarmont, and Daubrée, in making artificial quartz, have shown that gelatinous silica and glassy silicates are attacked and dissolved by highly heated waters, either alone or assisted by hydrochloric or carbonic acid, and that such solutions deposit hexagonal pyramids of quartz. These interesting quartz groups in the iron beds point conclusively to the exudation, from the serpentine rocks below, of warm springs, at whose mouths, upon cooling and removal of pressure, the quartz pyramids have been formed. Their amethystine hue is attributable to manganese, which is a prevailing ingredient of the iron ore of this region.

As to the source of the silica, it is a possible hypothesis that it has been supplied in a soluble form from the slow change involved in the decomposition of hornblende masses, and the formation of serpentine. In such a change there would certainly be a discharge of silica or silicates, and they would naturally enter into solution in subterranean

waters, which were themselves active agents in bringing about the very decomposition from which these products result.

Finally, the interrupted crystallization, to which we have especially alluded, suggests that there has been rapid cooling and *motion*, such as would occur at the orifice, and along or around the mouths of springs; unlike those magnificent results in Arkansas, where brilliant, sharply-cut, and long crystals, would seem to indicate a slow growth of the quartz prisms in a dense solution.

Mr. Arthur Hollick showed specimens of *Anemone hepatica* L., the common Liverwort, collected in full bloom at Prince's Bay on February 16th. This is the earliest recorded date at which it has been found in blossom on Staten Island, and is another evidence of the phenomenally mild winter. Following are the earliest recorded dates at which this flower was found in blossom in previous years:

1871	March 25th	1880	not recorded
1872	April 11th	1881	April 10th
1873	April 10th	1882	April 1st
1874	March 21st	1883	April 8th
1875	April 10th	1884	April 20th
1876	April 1st	1885	April 25th
1877	March 24th	1886	April 11th
1878	March 10th	1887	April 17th
1879	March 29th	1888	April 15th
		1889	April 14th

In nearly every instance the plants were examined carefully about a week or two previous to the dates above recorded, hence they could not have been in blossom many days earlier. As the location of plants makes a great difference in the time of flowering all these observations were made at the same or similarly situated localities, namely, sheltered banks with a southern exposure, either near the Crystal Water Co.'s reservoir, the Black Horse Ravine, or the pond near Prince's Bay. The plants in the latter locality are slightly in advance of the others and a week or more ahead of the average.

The following objects were shown: A cannon ball, presumably a relic of revolutionary times, presented by Mr. S. N. Havens, who had dug it up while excavating in the woods not far from the new Smith Infirmary building. A stone axe and arrow-head, presented by Mr. M. T. Merrill, which had been dredged from the bottom of the Kills near Linoleumville. The articles were encrusted with barnacles and Bryozoöns.

SCIENTIFIC NEWS.

5. Notes on the Paleontological Laboratory of the United States Geological Survey under Professor Marsh.

If there is any truth left under the sun then judgment must fall on the scientist who walks the halls of the Yale Museum armed with a wet sponge. Why a wet sponge? you say. Perhaps it was to wipe the dust from some noble fossil? Far from it! but rather to wash the purity of a truth out of the blackness of a falsehood. A kind of organized touchstone that distinguishes the little gold from the bulk of dross, which when deftly swept across the surface of a restored fossil, discloses the real and the unreal. For plaster of paris is porous, and absorbs more readily than the denser fossil any moisture from the sponge. So the blackened sepulchres yield up their grewsome skeletons. Veritable sepulchres they necessarily seem to those who have seen these fossils "black-washed" from centrum to spine, from shaft to extremities, reducing the whole to a uniformity of color that wiped out absolutely every vestige of the truthful white plaster, leaving mankind in doubt as to what is real, what conjectural. This is illegitimate restoration in the eyes of the whole world, and these old bones, restored to deceive rather than to instruct, must sooner or later stand as monuments of reproach to the man who has so far deceived the world and himself that he can only study them with a wet sponge.

To those scientists in foreign lands, especially Germany, who have marveled at the exceptional beauty and perfect preservation of Prof. Marsh's specimens, let it be said that although you cannot apply the sponge test to his faultless, fractureless plates, you can to the specimens from which they were drawn. But to see any man year after year calling for a wet sponge to assist him in determining whether a suture or a fracture were real or imitations wrought cunningly in the plaster by skilled labor, is to believe him worthy of the unqualified distrust of science, wherever that word is spoken. One feels this the more keenly when he knows that all his assistants to a man have repeatedly advised with him, and cried out against this abuse, warning him of the criticism inevitably resulting from such a stubbornly unscientific and misleading course. His assistants are asked, not how nearly they can approximate the truth, but instead, "How closely can you imitate the color and texture in that missing part?" which being translated is, How cunningly can you deceive? "That part looks too smooth; can't

you work in a crack or two to give it a natural look?" "Just run a suture along here, and scrape that process there to make it look like the roughnesses for cartilaginous or ligamentous attachment."

At first the plaster worked badly, for many of the bones were black, and to get that color in white plaster it was necessary to add such quantities of lamp-black (with alcohol to make it mix with the water) that the restored parts were soft and crumbled away. To overcome this, glue water was added, which gave hardness, but like all glue was treacherous, drying, cracking, scaling off and pulling away from its moorings, thus exposing too clearly just where the fossil left off and the fraud began. It was not until he had learned how to combine plaster, bone-black, and gum acacia, that a mixture capable of unlimited possibilities was adopted. Were it possible, I would say, Verify these words,—but you can't. Stand straight before these restored specimens, in the full and truthful light of day, and you can't distinguish between the rusty, frost-cracked, weather-beaten, moss and lichen effects, craftily wrought in the plaster, and the conditions wrought by time on the specimens themselves. But if critical study can reveal—without the helpful sponge—the restored parts in some bones, it can't in others, some of which were prepared by myself, at his direction, in my earlier days on the Survey, and are so craftly modeled and colored that I cannot myself distinguish at arm's length the real fossil from the plaster. Of course the deceits and falsities of the specimens thus tampered with were naturally enough transmitted to the drawings, and the old deceits and falsehoods were enacted anew—compromising that pre-eminently reliable Journal. Yes, still a third time, in the costly plates of the government monographs, thence to be copied and repeated in other ways, how often who will say?—for a falsehood is proliferous and self-propagating. If the deceptions thus practised were confined to the specimens themselves, and not transmitted to paper and then distributed throughout the world, it would not seem so serious an evil. As it is, the Geological Survey must necessarily suffer reproach either now or in the future.

Geologists abroad who cannot acquaint themselves personally with the facts, may find in the above an explanation of the striking absence in Professor Marsh's plates of those conventional bars, light shading, and simple outlines which fair-minded scientists universally use to honestly indicate missing parts. In very marked contrast to his course is that of foreign geologists, and our own paleontologists. Their plates show things as they actually are, and are not daubed with plaster to enlarge, distort, or conceal anything at the caprice of the

author. (Figs. 1, 2.) Another phase of this extensive restoration business is worthy of notice, and is thoroughly culpable. Professor Marsh gave tacit and oft-repeated directions "not to do a stroke on a Government fossil that was not absolutely necessary." "I am not doing missionary work for the Government," "They can do the fancy work at the National Museum; we will only work them out just enough to see what they are, and they can do the rest there." But bear in mind that all this time he was doing home missionary work on his own private collections, and at Government expense too; restoring, and embellishing, and mounting them on plaster bases and other supports ready for exhibition. "Life was too short" to give a Government specimen more than a lick and a promise, but quite long enough to devote months and years of Government time and money in beautifying his own private collections, and that too when they had all been drawn, and lithographed, and all the measurements had been

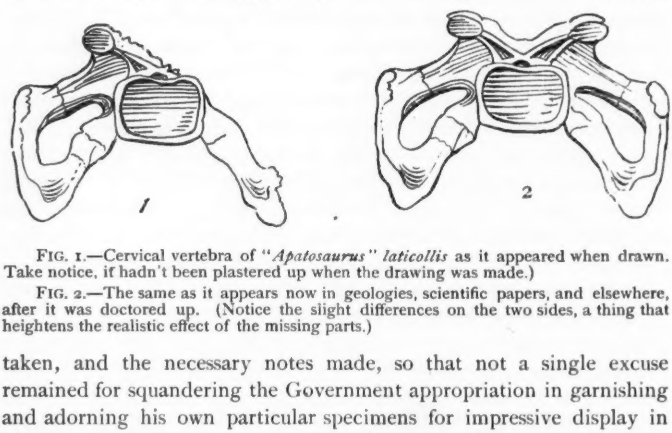


FIG. 1.—Cervical vertebra of "*Apatosaurus*" *laticollis* as it appeared when drawn. Take notice, if hadn't been plastered up when the drawing was made.)

FIG. 2.—The same as it appears now in geologies, scientific papers, and elsewhere, after it was doctored up. (Notice the slight differences on the two sides, a thing that heightens the realistic effect of the missing parts.)

taken, and the necessary notes made, so that not a single excuse remained for squandering the Government appropriation in garnishing and adorning his own particular specimens for impressive display in his own particular museum. This abuse of public trust led us to frequent and spirited disagreements and our relations became exceedingly strained, and still more so when I refused to add to the crime of misappropriating Government time that of deceiving in the restorations. For he not only wished to have the deceptive plaster used in the restorations, but insisted on having the bones so modeled as to exactly correspond with the lithographic plates already drawn, and that too after being repeatedly informed that to secure this similarity would necessitate distorting and even breaking the fossils.

Once when I frankly gave him my opinion of this wholesale misuse of the Government men and money for his own personal benefit, he

declared that the power vested in him as Paleontologist was such that it enabled him to apply his appropriation in collecting recent Birds or Mammals in South America, or in hiring musicians for his entertainment while at work, if need be. On another occasion when I rose in opposition to this same wrong his reply was so strikingly characteristic that it seems worth while to reproduce it from my note-book, to whose unerring memory I entrusted all such matters. * * * "On one occasion when I complained to him frankly that it seemed wrong to employ so many of his force on private work, and that too much of that sort of thing was done by him daily, and cited as one of several instances the time when so many were engaged for more than a year in making a restoration in papier-mache of his (so-called) *Dinoceras*, he said, "Now I simply say this to you, I *have a contract direct with the Government for the restoration of Dinoceras*. What do you say to that?" There was nothing for a gentleman to say to so straightforward a statement, but I could scarcely believe my senses a moment later, when he explained that he had asked me as a favor to help him out,—that the time required for the completion of these restorations had been so gravely miscalculated that it had taken twice as long as they had judged to finish them, and he was sick and tired of the whole matter. "Besides it had cost tremendously, and, *every cent comes out of my own pocket*." Then I suggested that heads of departments with "contracts direct with the Government" didn't pay for things out of their own pockets. He declared several times that I didn't understand. "You see it is this way; I am going to make the restorations, and the Government assures me it will pass a bill to pay for them, so you see it is all right." The strikingly characteristic part of it is that he really hadn't a contract when he said he had. When the investigating committees shall have inquired into the exact price the Government has paid for one paper model of Dinoceras (and a frail one at that) some interesting figures will surely come to light. His zeal to out-rival all others in the startling size of his fossils has led him to send out casts of heroic stature, and you natives and foreigners who have the great saurian femur ("*Atlantosaurus*" *immanis*) "exceeding eight feet in height," may saw off a two-foot back-log from the same, and then it will stand as high as it does in the Yale Museum to-day. And you authors of manuals of Geology, written in all sincerity for the honest and reliable instruction of the youthful mind, may lop off the same amount of plaster from your clean text. Neither was the huge Saurian one hundred feet long, nor was its great thigh bone over eight feet in

length. It should be further stated for your information that the author of this greatest of femora allowed this mistake to remain uncorrected in the proof of Dana's Manual of Geology, which was submitted to him, after he and all around him could not help knowing it was false. [Figs. 3, 4.] And you students in universities and colleges throughout the world may turn to page 433 of Dana's Manual of Geology (third edition) or to page 462 of LeConte's Elements of Geology, or to page 779 of Geikie's Elements of Geology (not to mention other authors, for who can follow a deception through all its infinite ramifications!) and may draw your merciless pen through "more than eight feet high" and write "more than six."

3.

4.

FIG. 3.—Femur of "*Atlantosaurus*" *immanis* as it stands in the Peabody Museum to-day (more than six feet high).

FIG. 4.—Cast of femur of "*Atlantosaurus*" *immanis* (more than eight feet high), sent out to the museums of the world.

In ordinary cases the world would relegate this to the category of mistakes, but when the fragments refuse absolutely to go together, and when a skilled foreign modeler tries for days to reconcile fact with fiction, and tells his employer so, and when he "must match the pieces" by building them up with modeler's clay, then it is that the mistake looks so deliberate that the world withdraws its mantle of charity.

Plaster in bulk is cheap we know, but, when misused, will cost a man his reputation. When Professor Marsh made his notorious "*Bison*" *alticornis* blunder,—describing, for a second time at least, a reptile as a mammal,—the horns as they came in from the collector were not satisfactory,—from a bison standpoint,—and were straightway broken apart, straightened up, and given the "proper sweep."

All the ugly chinks were filled with the ever-ready mixture, and the helpless old "*Bison*" *alticornis* came out of it all with a nobility of front creditable to the king of bisons himself, but with his personal appearance so touched up withal that he couldn't tell himself whether he was a bull bison from the Tertiary, or an outraged reptile from the Mesozoic. Nor could anyone for that matter. But when future generations shall have chiseled away the plaster from the cavities, foramina, and sutures, its real identity may be re-established (Figs. 5 and 6).

FIG. 5.—The horns of "*Bison*" *alticornis* Marsh, as nearly as they appeared when received as is possible in their present condition. Colored plaster, once applied to a specimen, cuts off much that is worth knowing.

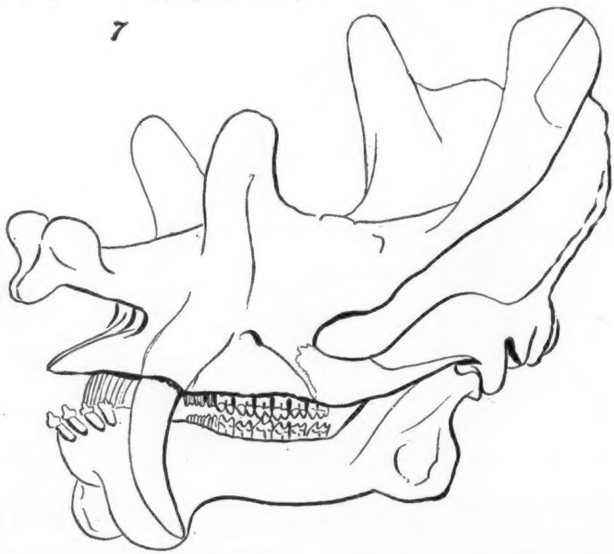
FIG. 6.—The same as they appear in the illustration, with no hint of the colored plaster. See *American Journal of Science*, Vol. XXXIV., October, 1887.)

But in the mean time illustrations of the "Bison" horns go out to the world (see *American Journal of Science*, Vol. XXXIV., October, 1887), but without the slightest intimation of the plaster hiatus there. Now that it turns out a horned reptile, and not a bison at all, he neither represents the live animal, nor the specimen as it came from the quarry.

Fortunately, a plaster of Paris deception, once set, is just the hard and lasting, and perfectly tangible sort of falshood that Science, without reserve lays rough hands on. And the day has at last come, we hope, when specimens from the plaster of Paris formation will no longer be accepted by science as fossils, and the "Plasterosauri,[1]" and "Plasterotheria" will be things of the past.

In his great antedated volume on the Dinocerata, the figures of his so-called *Dinoceras* and *Tinoceras* are plump with plaster. Why, in these plates of the Dinocerata many of the skulls and bones show not a trace of their construction! How strongly contrasted with this are the methods of all other American and foreign geologists, both as regards the specimens themselves, and the illustrations of them. These true paleontologists figure what they have, and do not figure what they have not (Figs. 7 and 8).

7



FIGS. 7 and 8.—Skulls of the Dinocerata, introduced to illustrate differences of treatment by different authors. FIG. 7.—Skull of *Loxolophodon ingens* Marsh, illustrating fairly the whole work on the Dinocerata. It will be noticed that the figure is free from anything suggestive of the blemishes covered up with colored plaster.

Speaking of *Dinoceras* and *Tinoceras* brings to mind that interesting time when his review of the Dinocerata, admittedly prepared by

[1] Plasterosauri not original. A name facetiously applied (to the great merriment of the force) by a Yale professor, to whom Professor Marsh was showing his various *Sauri*.

himself, was signed by the initials of his type writer amanuensis, after it had been rejected by two of his assistants; facts that were generally known and commented on by his assistants at the time. But where are the bones of *Tinoceras?* I have not seen them myself, save a skull, and one or two foot bones, and possibly a pelvis, and assistants best informed on this group declare that but few existed at all Yet the superb plate shows not a missing bone save a few caudals. Every vertebra, every rib, all the limb bones to the smallest bones of the feet, are perfect. Such a complete specimen was never known. There is a hole in the saucepan somewhere. Then too, it is my distinct and positive recollection that when preparing the restoration of

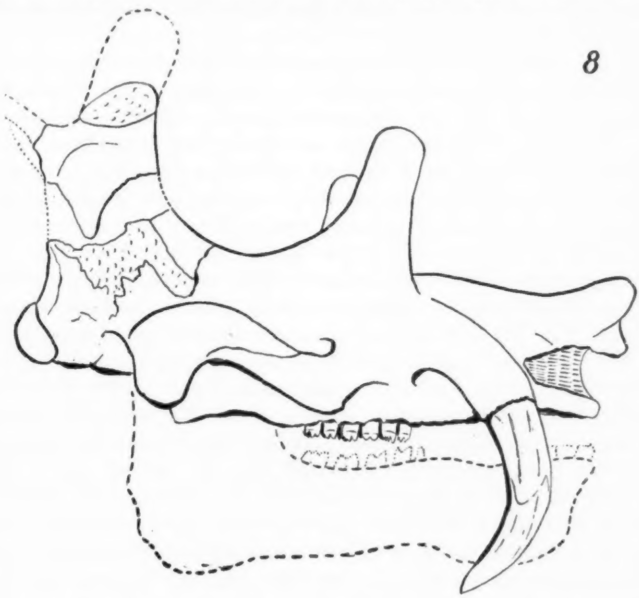


FIG. 8.—*Loxolophodon cornutus* Cope, from Cope's plate in the Tertiary Vertebrata.

Tinoceras he gave directions that the drawings of *Dinoceras* be enlarged one-fifth, and have a three-quarter view instead of side view, so that it wouldn't look too much like *Dinoceras.* These facts were rather freely criticised at the time, leading us often to mirthful considerations of the unusual elasticity of conscience which a Government paleontologist must have to stick the head of one individual on the

enlarged carcass of another, and to found thereon a new genus and species for publication in an official monograph. Out of all this is evolved a paleontology so untrammeled by scientific conventionalities that it is free and spotless from those ugly cross-bars, light shading, and simple outlines indicative of missing parts, and quite as free from acknowledgment of priority, and recognition of the works and discoveries of others. But high art paleontology, not content with the omission of tell-tale bars and outlines, goes, with its long acquired momentum, still farther, and produces plates with such ingenious similarities and differences that the very elect are deceived by the realistic effects shown in the missing parts. These are flanked with text fraught with such subtleties and ambiguities that highly-plastered up impressions are easily conveyed.[2]

In substantiation of the frequent charges that Professor Marsh preempts land to shut out other geologists, I am ready to add my weight of testimony. More than that, he himself tells of putting hindrances in the way of younger geologists, for when one of his workmen said one day that "Professor Osborn had published a paper with a restoration of Brontotherium," he came to my room greatly agitated, declaring that Professor Agassiz had simply played him false, having promised that Professor Osborn should not see the collections at Harvard at all, and then he not only let him see them, but also describe them. When a former assistant secured a desirable position, Professor Marsh vowed if he had only "known it sooner the man would never have gotten that place." Not only does he avoid helping his assistants to better positions in geological fields, but he often hinders them by trampling on their good names when gone. We assistants watched the evolution of a falsehood from his lips, from the day when he said, "that man has resigned" to the month when he said, "I had to let him go; he was a bad lot," until still later he "dismissed him because he was unreliable and light-fingered." Thus it happens that some judicious assistants on resigning have shown commendable forethought in requiring of him papers, showing that they were not dismissed, as protections for their character against evil words and insinuations. Then by his ever-recurring, never-ending expressions of hatred and distrust, Professor Marsh methodically tries to fill to saturation the minds of his young assistants with prejudice against his contemporary in paleontology (Professor Cope). These are but allusions to his

[2] When one writes that "the diplosphene has long been known," the uninitiated might never suspect that the word had been coined for the occasion, to overthrow a name "hyposphene," proposed by a contemporary for a new osteological point.

hindrances put in the way of others in his attempts to monopolize paleontology in the East and West.

Can the people see the Government specimens? No, they cannot! and in all justice to the present management, possibly there is no reason, as he claims, why they should. After Professor Silliman and Professor Cope "went through" his collection, as Professor Marsh charges, we were directed not to admit even Professor Silliman or any of the Yale faculty, much less a stranger,—a demand so unjust that I for one refused, once for all, absolutely, to do anything of the sort. Newspaper men were particularly guarded against, even the editors of the college papers. Professor Benjamin Silliman was not only a member of the Yale Faculty, but was also one of the trustees of the Yale Museum, and I am one of the "two witnesses" who saw Professor Cope, at the invitation of Professor Silliman, "commit his depredations" on Professor Marsh's "private specimens," by walking through his open rooms. Professor Silliman and Professor Cope spent but a few minutes in each room. I saw them come and go. Professor Cope scarcely looked at the specimens, and didn't touch or uncover one, as I will testify under oath, Professor Marsh notwithstanding. So the scandalous half column devoted to the "depredations" and "outrages," and other designedly damaging statements, has only the most visionary foundation on fact. That his connection with politics should lead him to stoop from the high plane of a scientist to that of a scheming demagogue is a disgrace worthy of publicity. It is just such traits of character as this that have cost him the friendly support of all his assistants. A certain faithlessness runs through all his doings, so it is not to be marvelled at that it crops out in cuts and text. One important assistant, on private pay, not independent at the time (drawing a small salary, not half his just deserts), was asked as a favor to be listed on the Government pay-roll, to which he readily agreed as a matter of accommodation, only to find, the next quarter, that his salary had been cut down two hundred dollars. These facts, and many that are necessarily suppressed for the nonce, in consideration of the present members of his force, coupled with his insincerity in scientific work, will help to explain why the *personnel* of his force undergoes such constant and rapid change. High-spirited young men, college graduates, cannot and will not tolerate such associations and environments.

In the matter of drawings, Professor Marsh sacrifices veracity and honor to secure high art in his illustrations, and the Government pays the bill. Not only does he assiduously avoid combining figures on the

plates, but he makes all drawings on a large scale, necessitating many double and quadruple folded plates.

He even goes to an extreme that is simply culpable, and makes some drawings natural size. To be specific, one such plate, representing a full-length drawing of an enormous caudal vertebra of "*Brontosaurus*" *excelsus*, is not far from three feet wide by four feet long, nearly equaling sixteen plates of ordinary size. Any lithographer can tell you about what the Government doles out for luxurious display of this sort. One plate would have given a very liberal space indeed for the figure of this unimportant caudal. The idea that to be scientific drawings must be full length! Let us rejoice that Professor Marsh is not called upon to write up, at the expense of the people, the natural history of the whale. But the cost of gorgeous plates is a mere bagatelle to the public treasury compared with the waste resulting from his natural indolence and mismanagement. Just think of leaving a large force of men without superintendence; no one to direct or advise! As a matter of practical business experience such a method is simply disastrous, and right here we may look for a rational explanation of the fact that Professor Marsh accomplishes but little, although his force is large and competent. He actually compels the men to hunt for work, instead of so appointing it as to secure their best efforts, and in general manages with such culpable deliberation that Government contracts for monographs lapse unnecessarily,[3] and in twenty-five years two monographs only appear to show for the talent and appropriations expended! But Ease finding itself outwitted by Industry, ingeniously catches up with all rivals by an antedate,[4] and we record one more quibble in the growth of a monograph.

On consulting my books I find myself writing indignantly about this matter as much as four years ago, and mentioning his spending every moment on trivial details which concerned the workmen only, instead of inspiring greater effort, or urging on the work as a whole. Or, as Mr. Harger has often told me, to illustrate Professor Marsh's eye for the small things, "I have seen him sign his approval to a plate having the name spelled wrong, and even the bone upside down, without seeing either mistake, but a comma with a broken tail had been carefully marked." (The entire edition of two plates was printed with the bones wrong end up.) Countless petty things

[3] As the author remembers it, each of three contracts for monographs have lapsed, been renewed, and lapsed a second time.

[4] The reference is, of course, to the Dinocerata, antedated to keep pace with the Tertiary Vertebrata, published in 1885, but before the Dinocerata.

detained him from the museum, such as buying Jersey cows, orchids, etc. A calving cow has detained him till dark—that, too, at a time when he was to leave the next day to be gone a fortnight. With even moderate industry his Sauropoda contract could not have lapsed, nor could his Stegosauridæ and Brontotheridæ contracts have shared a like fate. In all justice, however, to Professor Marsh, it should be stated that the best interests of the Survey demand that he should have the utmost freedom in going, coming, or absenting himself outright from the laboratory. But this does not excuse him for leaving his force without some one to systematize, plan, and direct the work effectively. Then his inefficient business methods as regards the salaries of his assistants lead to endless friction and general dissatisfaction. Not only does he dole out the pay quarterly,—not monthly, as the Government does,—but often, even then, postpones the pay-day from two or three days to as much as three weeks, and then at the end of this time makes matters still more annoying by all sorts of petty quibbles, and what we called "Marsh's tricks." On one occasion, during my earlier experiences on the Survey, he handed me the vouchers and a receipt in full, all of which were duly signed. He in turn signed a check for payment in part (deducting some fifty dollars), which he handed over, explaining in all candor that "the balance would be made good at the end of the year." "It's a way they have on the Survey." But as it was a way I didn't have, and "though his word was as good as his bond," another check was forthcoming. Forgetting this failure, the same untrue and unfair game was tried again later with like results.

His unpardonable neglect of proper superintendence costs the Government far more than all his sumptuous high art works on paper and in plaster. The only time when Prof. Marsh does show signs of real industry is when he rushes precipitately into the description of a "new genus." Utterly disregarding the advice of his ablest assistants, and neglecting those thorough investigations which might check his growing list of useless generic names, he describes his specimen on the first impulse, and his list is swelled by one more name. A sacrum comes in "consisting of only three vertebræ" (the other two knocked off): he sees in it a "totally different genus," and though it is contrary to all probability and to the advice of his assistants, he industriously founds a new genus and species on it. (See *American Journal Science*, Vol. XVII., January, 1879; also text-books of geology.) Should the Geological Survey by any chance be crippled by the recent overhauling of Prof. Marsh's methods, it would be a national loss, but it is

certain that the present paleontologist deserves such a reprimand that he will be forced to adopt methods recognized as legitimate by scientists. Whether such men as Prof. E. D. Cope, Prof. Persifor Frazer, Dr. T. Sterry Hunt, Dr. F. M. Endlich, and others, are moved by envy, malice or hate in agitating this geological controversy, matters little—that is precisely the cheap kind of retort the world expects; yet the fact remains that Prof. Marsh's assistants and others are marshalled against him also. No man engaged in scientific pursuits, however flanked by wealth and influence, can possibly hope for the support of high-minded, honorable men, if his course is such as to lay him plainly open to charges of trickery, plagiarism, illegitimate methods, disregard of the works of others, the rights of priority, and incompetence in general. Although the present paleontologist may, by the very weight of his official position and influence, avoid the scrutiny of an investigating committee, which in common justice he should not escape, he cannot but be weighed in the balance by scientists and found wanting.—ERWIN H. BARBOUR, PH.D.

Iowa College, March 15, 1890.

Die Spinnen Amerikas.—The death of the German araneologist, Count Keyserling, made a large breach in the little circle of working araneologists. It was known that he had left a large amount of manuscript for the concluding parts of his work, "Die Spinnen Amerikas," and this, it was feared, would be lost to science. But the publishers, with praiseworthy enterprise, have resolved to complete Keyserling's work as far as possible after the original plan. They failed, however, to find any one in Europe who would edit the finished manuscripts and complete the fourth volume, which treats of the Epeiridæ. In this emergency they solicited the aid of Dr. George Marx, of Washington, D. C., who has at last consented to undertake the task. Being a thorough German scholar and a well-furnished araneologist, Dr. Marx is admirably equipped for this duty. A large part of Count Keyserling's manuscript, which was in a good degree of forwardness, has already been edited, and will soon be ready to transmit to Germany. Dr. Marx will then edit the notes upon the Orbitelariæ, and add descriptions of the species which Keyserling had not reached at the time of his death. He will thus contribute about one-third of the matter in what will constitute Volume IV. of "Die Spinnen Amerikas."—HENRY C. McCOOK.